NOTICE: This document contains references to Varian. Please note that Varian, Inc. is now part of Agilent Technologies. For more information, go to **www.agilent.com/chem.**

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Micro-GC

User Manual

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Printed in the Netherlands

CP501265490 Rev:1 November 2009

Varian Analytical Instrument Warranty

HARDWARE PRODUCTS

All analytical instruments sold by Varian are warranted to be free from defects in material and workmanship for the periods specified and in accordance with the terms on the face of Varian's quotation or as otherwise agreed upon in writing between Varian and the Customer. The warranty period begins on the date of **shipment** from Varian to the original Customer. However, where installation is paid for by the Customer or included in the purchase price, the warranty period begins upon completion of installation. If the Customer schedules installation to start later than 30 days after delivery or if such delay is caused through the Customer's inability to provide adequate facilities or utilities or through failure to comply with Varian's reasonable pre-installation instructions or through other omissions by Customer, then the warranty period starts on the 31st day from date of shipment. Moreover Varian will charge the Customer for labor and other expenses involved in making multiple or follow-up installation service calls.

SOFTWARE PRODUCTS

Where software is provided within the frame of a license agreement concluded between the Customer and Varian, any warranty shall be strictly in accordance with the terms of such agreement.
In the absence of a license agreement and unless an alternate warranty period is agreed upon in writing between Varian and the Customer, the warranty period is as specified on the face of Varian's quotation. Varian warrants such software products, if used with and properly installed on Varian hardware or other hardware as specified by Varian to perform as described in the accompanying Operator's Manual and to be substantially free of those defects which cause failure to execute respective programming instructions; however, Varian does not warrant uninterrupted or error-free operation.

REMEDIES

The sole and exclusive remedy under hardware warranty shall be **repair** of instrument malfunctions which in Varian's opinion are due or traceable to defects in original materials or workmanship or, at Varian's option, **replacement** of the respective defective parts, provided that Varian may as an alternative elect to **refund** an equitable portion of the purchase price of the instrument or accessory.
Repair or replacement under warranty does not extend the original warranty period.
Repair or replacement under warranty claims shall be made in Varian's sole discretion either by sending a Customer Support Representative to the site or by authorizing the Customer to return the defective accessory or instrument to Varian or to send it to a designated service facility. The Customer shall be responsible for loss or damage in transit and shall prepay shipping cost. Varian will return the accessory or instrument to the Customer prepaid and insured. Claims for loss or damage in transit shall be filed by the Customer. To correct software operation anomalies, Varian will issue software revisions where such revisions exist and where, in Varian's opinion, this is the most efficient remedy.

LIMITATION OF WARRANTY

This **warranty does not cover** software supplied by the Customer, equipment and software warranted by another manufacturer or replacement of expendable items and those of limited life, such as but not limited to: Filters, glassware, instrument status lamps, source lamps, septa, columns, fuses, chart paper and ink, nebulizers, flow cells, pistons, seals, fittings, valves, burners, sample tubes, probe inserts, print heads, glass lined tubing, pipe and tube fittings, variable temperature dewars, transfer lines, flexible discs, magnetic tape cassettes, electron multipliers, filaments, vacuum gaskets, seats and all parts exposed to samples and mobile phases.
This **warranty shall be void** in the event of accident, abuse, alteration, misuse, neglect, breakage, improper operation or maintenance, unauthorized or improper modifications or tampering, use in an unsuitable physical environment, use with a marginal power supply or use with other inadequate facilities or utilities. Reasonable care must be used to avoid hazards.
This warranty is expressly in lieu of and excludes all other express or implied warranties, including but not limited to warranties of merchantability and of fitness for particular purpose, use or application, and all other obligations or liabilities on the part of Varian, unless such other warranties, obligations or liabilities are expressly agreed to in writing by Varian.

LIMITATION OF REMEDIES AND LIABILITY

The remedies provided herein are the sole and exclusive remedies of the Customer. In no case will Varian be liable for incidental or consequential damages, loss of use, loss of production or any other loss incurred.

Safety Information

INFORMATION

In accordance with Varian's commitment to customer service and safety, this instrument and its accompanying documentation (NEN 5509) complies with the CE specifications and the safety requirements for electrical equipment for measurement, control, and laboratory use (CEI/IEC 1010-1), $_{c}CSA_{us}$ and FCC-b.

This device has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area is likely to case harmful interference in witch case the user will be required to correct the interference at his own expense.

To prevent any injury to the user or any damage to the instrument it is essential that you read the information in this chapter.

If this manual is not in your native language and if you have problems understanding the text, we advise you to contact your Varian office for assistance. Varian cannot accept responsibility for any damage or injury caused by misunderstanding of the information in this manual.

OPERATING INSTRUCTIONS

This instruction manual is provided to help you establish operating conditions, which will permit safe and efficient use of your equipment.

Special considerations and precautions are also described in the manual, which appear in the form of **NOTES**, **CAUTIONS**, and **WARNINGS** as described below (next page).

It is important that you operate your equipment in accordance with this instruction manual and any additional information, which may be provided by Varian. Address any questions regarding the safe and proper use of your equipment to your local Varian office.

NOTE

Information to aid you in obtaining optimal performance from your instrument.

CAUTION

Alerts you to situations that may cause moderate injury and/or equipment damage, and how to avoid these situations.

WARNING

Alerts you to potentially hazardous situations that could result in serious injury, and how to avoid these situations.

Warning Symbol	*Warning Description*
WARNING: Shock hazard	Indicates dangerous voltage: (terminals fed from the interior by voltage exceeding 1000V must be so marked).
WARNING: Burn hazard	Indicates parts that may cause burns when touched.
Instruction Manual	Indicates that the user should refer to the manual before operating the equipment.
Protective Conductor terminal	For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal, which must be connected to ground before operating equipment.
Radioactive hazard	Indicates that the instrument contains radioactive components, which may cause personal injury when handled incorrectly.
Skin puncture	Indicates sharp or suddenly moving parts such as injection needles that may cause injury.
Static discharge Warning	Indicates instrument contains parts that can be damaged by electrostatic discharge. Take care for proper grounding before handling.
Do not touch	Touching this item may result in damage to the instrument or personal injury.

GENERAL SAFETY PRECAUTIONS

Follow these safety practices to ensure safe equipment operation.

- Perform periodic leak checks on all supply lines and pneumatic plumbing.
- Do not allow gas lines to become kinked or punctured. Place lines away from foot traffic and extreme heat or cold.
- Store organic solvents in fireproof, vented and clearly labeled cabinets so they are easily identified as toxic and/or flammable materials.
- Do not accumulate waste solvents. Dispose of such materials through a regulated disposal program and not through municipal sewage lines.

NOTICE: This instrument has been tested per applicable requirements of EMC Directive as required to carry the European Union CE Mark. As such, this equipment may be susceptible to radiation/interference levels or frequencies, which are not within the tested limits.

This instrument is designed for chromatographic analysis of appropriately prepared samples. It must be operated using appropriate gases and/or solvents and within specified maximum ranges for pressure, flows, and temperatures as described in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

It is the responsibility of the Customer to inform Varian Customer Support Representatives if the instrument has been used for the analysis of hazardous biological, radioactive, or toxic samples, prior to any instrument service being performed or when an instrument is being returned to the Service Center for repair.

CAUTIONS

1. Disconnect the instrument from all power sources before removing protective panels to avoid exposure to potentially dangerous voltages.
2. When it is necessary to use a non-original power cord plug, make sure the replacement cord adheres to the color-coding and polarity described in the manual and all local building safety codes.
3. Replace faulty or frayed power cords immediately with the same type and rating.
4. This instrument should be placed in a suitable location with sufficient ventilation to remove gases and vapors. Space around the instrument must be sufficient to enable cooling of the instrument.

5. Before plugging the instrument in or turning the power on, always make sure that the voltage and fuses are set appropriately for your local power source.
6. Do not turn on the instrument if there is a possibility of any kind of electrical damage. Instead, disconnect the power cord and contact your Varian office.
7. The supplied power cord must be inserted into a power outlet with a protective earth ground connection. When using an extension cord, make sure that the cord is also properly grounded.
8. Do not change the external or internal grounding connections as this could endanger you and/or damage the instrument.
9. The instrument is properly grounded when shipped. You do not need to make any changes to the electrical connections or to the instrument chassis to ensure safe operation.
10. When working with this instrument, follow the regulations for GLP (Good Laboratory Practice). Take care to wear safety glasses and appropriate clothing.
11. Do not place containers with flammable liquids on this instrument. Spillage of the liquid over hot parts may cause fire.
12. This instrument may use flammable or explosive gases e.g. hydrogen under pressure. Be sure to be familiar with and to follow accurately the operation procedures prescribed for those gases before operating the instrument.
13. Never try to repair or replace any component that is not described in this manual without the assistance of a Varian service engineer. Unauthorized repairs or modifications will result in rejection of warranty claims.
14. Always disconnect the AC power cord before attempting any type of maintenance.
15. Use proper tools when working on the instrument to prevent danger for you and/or damage to the instrument.
16. The customer should not attempt to replace battery(s) or fuse(s) in this instrument other then specified in the manual.
17. Damage can result if the instrument is stored under unfavorable conditions for prolonged periods (e.g., subject to heat, water, etc.).
18. Do not shut off column flow when the oven temperature is high this may damage the column.
19. This unit has been designed and tested in accordance with recognized safety standards and designed for use indoors.
20. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.
21. Substituting parts or performing any unauthorized modification to the instrument may result in a safety hazard.
22. Changes or modifications not expressly approved by the responsible party for compliance could void the user’s authority to operate the equipment.

SPARE PARTS AVAILABILITY

It is the policy of Varian to provide operational spare parts for any instrument and major accessory for a period of seven (7) years after shipment of the final production run of that instrument. Spare parts will be available after this seven (7) year period but on an *as available* basis. Operational spare parts are defined as those individual electrical or mechanical parts that are susceptible to failure during their normal operation. Examples include relays, lamps, temperature probes, detector elements, motors, etc. Sheet metal parts, structural members or assemblies and castings, printed circuit boards, and functional modules are normally capable of being rebuilt to like-new condition throughout their useful life and therefore will be supplied only on an *as available* basis after the final production run of the instrument.

SERVICE AVAILABILITY

Varian provides a variety of services to support its customers after warranty expiration. Repair service can be provided by attractively priced service contracts or on a time and material basis. Technical support and training can be provided by qualified personnel on both a contractual or as-needed basis.

Varian Analytical Instruments Sales Offices

For Sales or Service assistance and to order Parts and Supplies, contact your local Varian office.

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VARIAN

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Introduction

Congratulations and thank you for purchasing the Varian, Inc. Micro-GC.
The Micro-GC is a powerful single or dual or quad channel high speed Micro GC suited for analyses of gaseous samples. This instrument is tailored to meet your needs. The columns are installed and the instrument as a whole has been thoroughly tested at our factory.
The Micro-GC incorporate technical advancements in **Micro electronic gas control** (EGC). The unique advantages of the allow column head pressure settings to become part of the GC method and can be programmed electronically.
The Varian, Inc. Micro-GC with Micro EGC allows you to optimize your analysis. Apart from the constant pressure mode, the Micro EGC in the Micro-GC allows you also to program the pressure over your column. Pressure programming improves not only the speed of the analysis, but it will give you the opportunity to run new and more extended applications.
The Micro-GC analytical channels can optionally be equipped with backflush and Micro-Gasifier capabilities thus optimizing the analysis even further.

NOTE

For problems or questions about your Micro-GC, please contact your nearest Varian, Inc. subsidiary or Varian, Inc. representative.

Preparing for Installation

Refer to the Pre-Installation Instructions (CP501289) for site preparation and unpacking information.

GAS SUPPLY

Gas quality specifications are listed in the reference document "Pre-Installation requirements Micro-GC CP501289".

GAS SAMPLES

- Do not introduce liquid samples into your Micro-GC.
- Type of samples: non-condensing gas
- Samples other than non-condensing gases (wet, vapors, particles and polymers) must be filtered in advance.
- Sample conditions: Non condensing gas between 0 and 110°C.
- Sample pressure between 0 and 100 kPa (1 bar, 15 psi)
- Outlet of sample container must fit to a stainless steel capillary of 1/16" outside diameter, provided with a Swagelok® female nut.

Micro-GC Installation

INSPECTION

The Micro-GC will arrive packed in one large box and one or more smaller cartons. Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to your local Varian office.

UNPACKING

Unpack the Micro-GC and accessories carefully and transfer to the work area, using proper handling techniques. Inspect the Micro-GC and accessories carefully for damage or signs of rough handling. Report damage to the carrier and to your local Varian office.

Avoid back strain or injury by following all safety precautions when lifting (heavy) objects.

The instrument has been protected during shipment by protection caps. Prior to operating, remove:

- At the back of the system all (plastic) caps (see picture below).

PACKING LIST

Micro-GC

Check the packing list to see if you have received all that you require.

Item	Part number
External sample filter kit	CP736729
Filters 5x for external filter assy.	CP736467
CD-ROM user manual Micro-GC	CP505532490
Ethernet cross over cable 2.8 m	CP740292
Locking nut	CP420200 x 4
Male Luer	CP420100 x 4
Front and back ferrule 1/16” SS x 2	CP471201
Capillary tubing SS 1/16” x 1.0 mm, 10 cm	CP4008
Capillary Ext. Filter	CP736879
Power supply 110V or	CP49PWR110
Power supply 220V or	CP49PWR220
Power supply 240V	CP49PWR240

Accessories

Item	Qty	Part number
Spare filters (5 pieces) for external filter	5	CP736467
Manual Micro-GC (hard copy)	1	CP501265490
Manual Micro-GC power supply (hard copy)	1	CP501267
Heated sample inlet elbow with frit	5	CP740434
Ethernet crossover cable 10 meter	1	CP740293
Ethernet crossover cable, 2 meter	1	CP740292
Combo card (Ethernet and Com ports), including 3 meter crossover cable (not for HUB)	1	CP740292
Aux power car cigarette lighter DC adapter	1	CP740291
Charger for battery pack	1	CP740427
Battery pack NiMH (rechargeable)	1	CP740328
Micro Gasifier 110 Volt	1	CP740431
Micro Gasifier 220 Volt	1	CP740432
Micro Gasifier 240 Volt	1	CP740433
Genie 170 BTU filter complete	1	CP739535
Genie 101 BTU filter complete	1	CP739534
Genie 170 standard filter complete	1	CP739536
Genie 170 BTU membrane	1	CP739531
Genie 170 standard membranes	5	392590004
Genie 101 BTU standard membranes	5	392590005

INSTALLATION

Install Gas Regulators and Set pressures

Carrier gas supplied from cylinders should have a two-stage pressure assembly to adjust the carrier gas pressure to 550 ± 10 % (80 ± 10 %). Set cylinder regulator pressure to match the Micro-GC gas inlet pressure
(see Carrier_gas_connection on page 15).

Carrier gas

The most commonly used carrier gas for the Micro-GC is either He or N_2. The recommended purity for carrier gas is 99.995% minimum.
See Carrier_gas_connection on page 15

Connect data handling peripherals

The Micro-GC must be connected to an external Workstation, on page 47 both to set up the method and to acquire data.
Workstations and other data handling devices are connected to the cable connectors inside the Micro-GC (see Cable_connectors on page 14 for more details).

- Hardware connection between the Micro-GC and Workstation (computer) is done by Ethernet connection. For additional information look here Cable_connectors on page 14.

Sample

Connect the sample to the using the sample-in connector situated at the front of the instrument (see front view on page 12).
Read chapter Sample Gas on page 16 for more important information!

> **Heated Sample line**
> To connect heated sample lines refer to Heated Sample line chapter on page 18.

Connect to Power

First, connect the power connector to the Micro-GC, then plug the power cord into an appropriate source of power.

Turn power ON

Turn on the Micro-GC using the power switch on the lower front of the instrument. The “READY” LED should light (after two minutes) when ready. (see Front_view on page 12).

Factory default states and settings

Your Micro-GC is shipped from the factory with default settings. The following is relevant information on the factory default states and settings:

- When the Micro-GC is turned on, the power LED will light up and the system will begin the Flush cycle procedure. The Flush cycle is a 2-minute cycle in which the various valves are activated and deactivated in order to flush the entrapped air from the manifold, valves, and tubing.

- After the flush cycle is finished, the method (the default method in this case), which was last active before the instrument was shutdown, is activated:

    - All heated zones will be set at 30°C.
    - The Detector filaments will be set to OFF.

If your system is supplied with a DMD (Differential Mobility Detector) detector all settings are factory installed. The complete DMD method for the instrument (customer) specific application is tested en installed inside the DMD.

INSTRUMENT OVERVIEW

FRONT VIEW

READY led

Led OFF: System NOT ready
Led ON: System ready

RUN led

Led OFF: No run
Led blinking: Run in progress

ERROR led

Led OFF: No error
Led blinking: Error present
See here for the complete list on page 72

POWER led

Led OFF: No power
Led ON: Power OK
Led blinking: Voltage < 10 Volt

SAMPLE 1 and SAMPLE 2

Sample gas inlet connector
See here for more details on page 16

POWER ON/OFF SWITCH

Switch the Micro-GC ON or OFF

BACK VIEW

VENTS

CAUTION

It is possible to connect long vent lines to these fittings in order to safely guide hazardous fumes to a fume hood or other appropriate vent.

DMD CONNECTOR

In DMD channel used as connector for transport gas.
See here for more details on page 6

CARRIER 1 CONNECTOR

Carrier gas input connector
See here for more details on page 15.

POWER CONNECTOR

Power IN connector (male).
See here for more details on page 20

INSIDE VIEW

Open the cover and the cable connectors will be visible.

ASSIGN IP-ADDRESS BUTTON

Holding down this button during power-up will set the “assign IP-address mode”
See Assign_new_IP_address on page 54

ETHERNET

Ethernet RJ45 connector for Ethernet installations.
See here for more details on page 50

COM 2 & COM 3

RS232 (2-wire) and RS485 (4-wire)-communication interface.
See here for more details on page 37

COM 1

RS232-communication interface.
See here for more details on page 37

ANALOG I/O

External Analog I/O signals.
See here for more details on page 38

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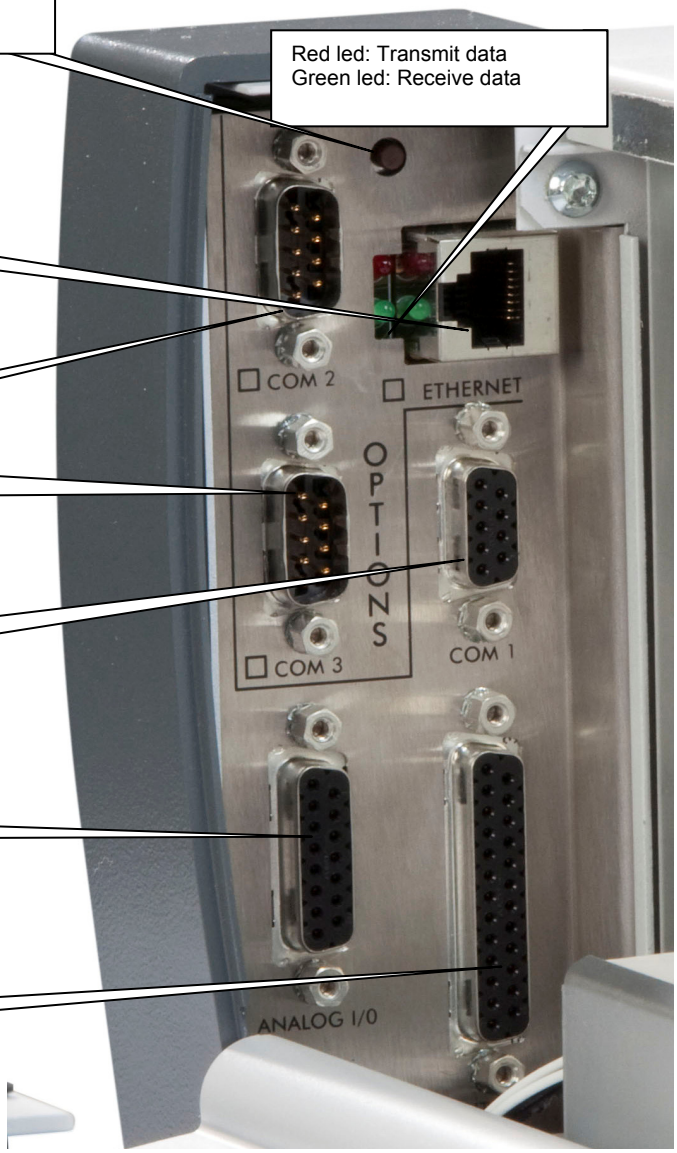
Digital in and output signals.
See here for more details on page 36



CARRIER GAS CONNECTION

The carrier gas line is connected from a carrier gas connection to the Micro-GC at the rear panel **CARRIER GAS 1 or 2** port.

Do not use any kind of plastic tubing since air will diffuse through the tubing, which may cause noisy baselines and decreased sensitivity. The metal tubing should be clean for GC use. Buy either flamed or chromatographically clean tubing.

Specifications for the carrier gas used on Micro-GC:

Pressure:	550 kPa ± 10 % (80 psi ± 10 %)
Purity:	99.995% minimum
Dry and free of particles:	CP-Gas Clean filters are recommended

CP-Gas Clean filters are recommended to remove any traces of moisture and oxygen. For low-level analysis a better grade of carrier gas should be considered. The type of analysis you want to perform determines the type of carrier gas used. The difference between the relative thermal conductivity of the carrier gas and the sample components should be as high as possible. Refer to the table for several relative thermal conductivities.

Hydrogen	47.1	Ethane	5.8
Helium	37.6	Propane	4.8
Methane	8.9	Argon	4.6
Oxygen	6.8	Carbondioxide	4.4
Nitrogen	6.6	Butane	4.3
Carbon monoxide	6.4		

Your Micro-GC is configured either for carrier gas He (or H_2) or it is configured for N_2 (or Ar). Make certain that the carrier gas selection in the controlling Workstation corresponds to the carrier gas connected to your Micro-GC. Use carrier gas corresponding this configuration. Changing type of carrier gas must only be carried out using the mandatory procedure in the Workstation software

If you are using hydrogen as carrier gas, pay particular attention to possible leaks at connections inside and outside the Micro-GC (use an electronic Leak Tester).

CP-Gas Clean filters are filled with nitrogen. If you are not using nitrogen as the carrier gas, flush filters and gas lines after installation of a new filter.

1HSAMPLE GAS

The Micro-GC is an analyzer built for the analysis of gases and vapors only. You are advised to prepare a non-condensing gaseous samples standard sample for routine check up of the instrument. Sample pressure should be between 0-100 kPa (0-15 psi), the temperature between 0 and 40°C ± 5°C of the analyzer ambient temperature and it must be filtered, preferably through a 5 µm filter. Varian, Inc. ALWAYS recommends the use of the external filter kit part number CP736729.
Click here for more details about the heated sample line on page 18.

WARNING

Liquids will seriously damage the instrument and should be avoided!

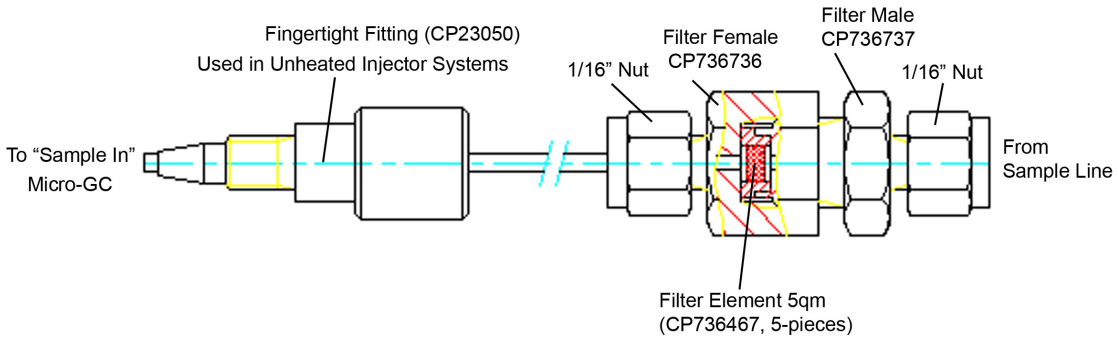
Handling a sample

If possible, filter and dry the sample before introducing it to the Micro-GC. It is advised to use an External Sample Filter Unit between the injector and the sampling device. The Filter, male must be hand tightened into the Filter Female, followed by a 1/8th turn with a 7/16" wrench. The arrow on the Filter Female should be directed towards the Fingertight Fitting. Replace the External Filter Unit on page 9 dat regular intervals.

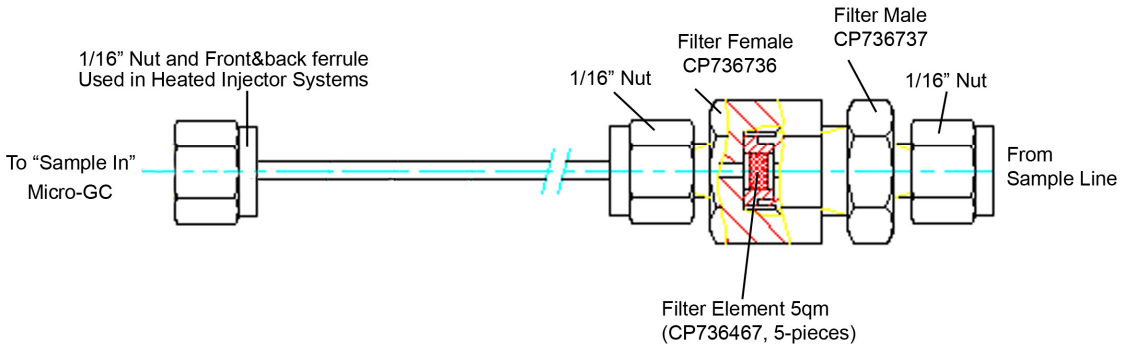
NOTE

Whenever possible remove moisture from samples introduced to the Micro-GC.

Unheated Injector Systems



Heated Injector Systems



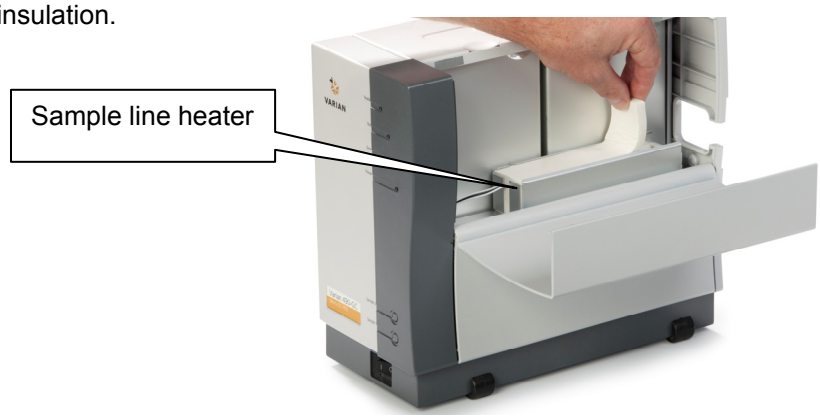
HEATED SAMPLE LINE

A heated sample line is always combined with a heated injector.
A heated injector and sample line is an option for a channel unit and is chosen in case condensable samples need to be analyzed and condensation in the sample lines needs to be prevented.
The heated sample and injector can be controlled between 30°C and 110°C.

Connect a heated sample line

Before connecting a heated sample line, allow the sample line heater to cool down to ambient temperature. The metal surfaces of the sample line heater are very hot and could burn your skin.

- Open the side panel, the heater will be visible.
- Remove the insulation.

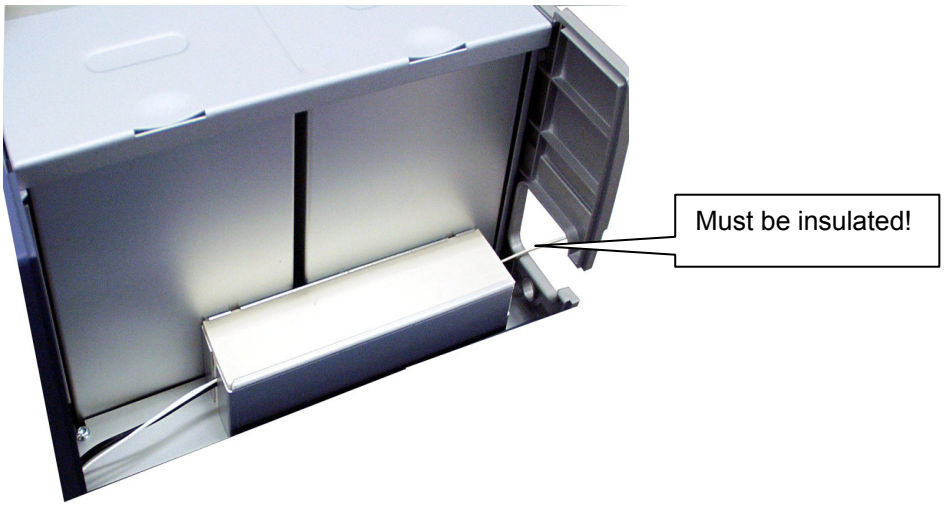


- The sample line connector will be visible.

- Connect the sample line.

WARNING

Insulate the sample line coming into the Micro-GC, this to prevent damage to the in/out coming cables.



2HPOWER

The Micro-GC requires 12.0 VDC, 130W maximum.
Refer to the User manual power supply for more information part number CP501267.

Only use the power supply that has been supplied with the instrument.

SHUT DOWN PROCEDURE

When the instrument is shut down for more then a few days please, carry out the procedure mentioned below

Create a method for all channels with the following settings:

- Filaments switched OFF.
- Column temperature set at 30°C.
- Injector temperature set at 30°C.
- Pressure set at 50 kPa (7 psi).
- Wait until the temperature of the column and injector is < 40°C (to protect the column), before switching off the Micro-GC.
- Remove the carrier gas tubing and plug all the vents/carrier gas connections with 1/8” brass nut or plastic cap.
- When the instrument is going to be used again then follow the procedure on page 21

LONG STORAGE RECOVERY PROCEDURE

Follow the recovery procedure below if your Micro-GC has been stored for a long period of time

- Remove the 1/8” brass nuts & plastic caps from all the vents/carrier gas connections.
- Connect carrier gas tubing and apply pressure on the Micro-GC, according the pre-installation requirements.
- Wait, at least 10 minutes, before switching ON the Micro-GC.
- Check immediately if the detector filaments are switched OFF, switch OFF if necessary .
- Set the column(s) temperature to the maximum allowed temperature.
- Condition the column module, preferably overnight. This will ensure that all the water has been removed from the column module and no damage will occur to the TCD filaments.

INITIAL OPERATION

A test method has been provided. This method has been designed to determine if the instrument is functioning properly and comes together with test chromatograms on which the test conditions are stated.

If you ordered a Molsieve column, make sure it is conditioned before use. See conditioning_Molsieve_columns on page 29 for parameters.

INITIAL RUN

SETTING UP THE TEST METHOD

To enter the method parameters, refer to the method set-up portion of the data-handling package manual.
Send the instrument parameters from the data-handling package software to the Micro-GC. You can watch the Micro-GC status in the instrument status tab.

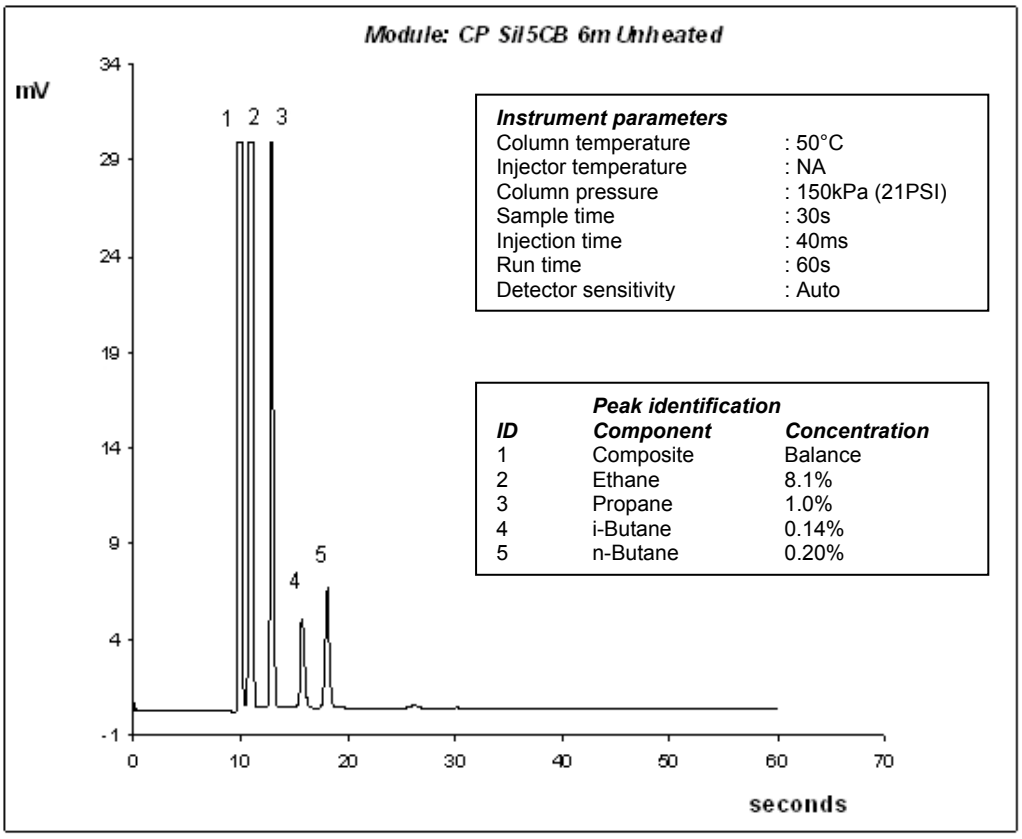
INJECTING THE SAMPLE

Connect the sample by means of a 1/16" line to the Micro-GC. You are advised to put an external 5 µm filter between the sample and the Micro-GC for additional filtering (see Sample_Gas on page 16 for more details).

Following are a few results on commonly used columns. CP-Sil 5 CB and CP-Sil 19 CB, HayeSep A and Molsieve. The sample is natural gas, which provides a convenient standard for testing the instrument in any configuration of these columns.

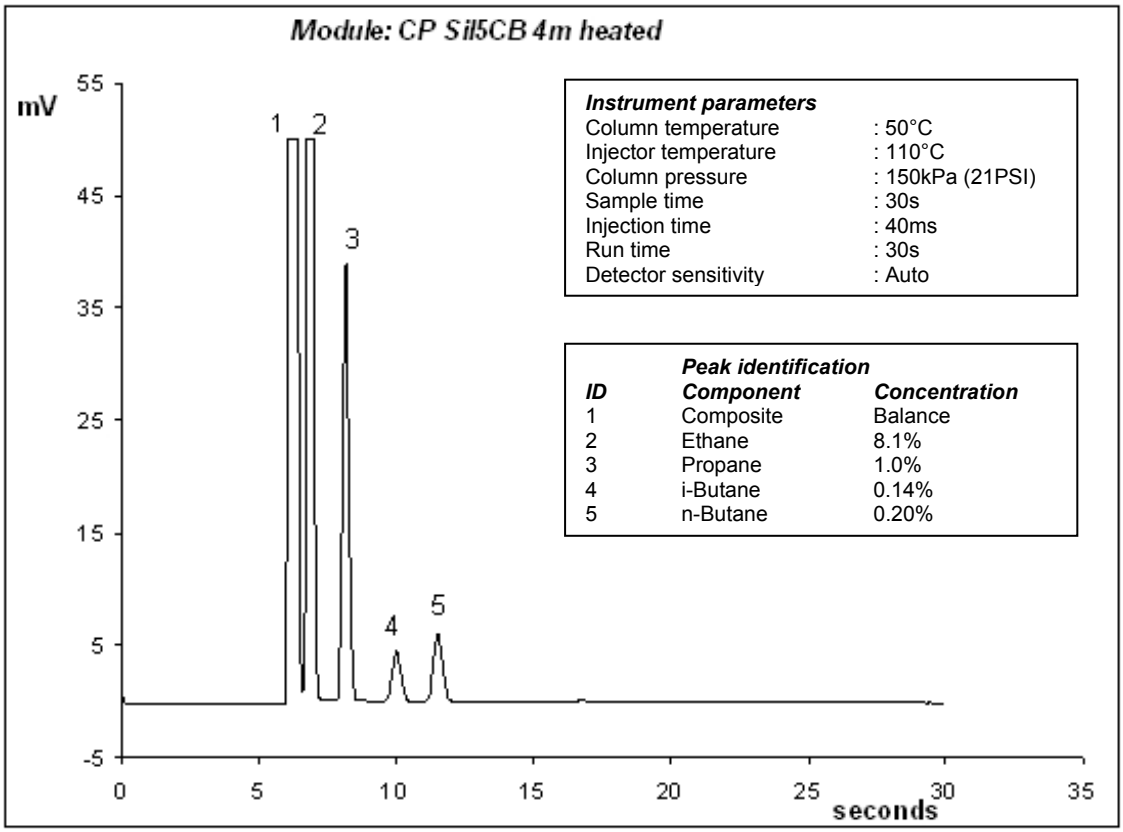
N_2	0.77 %	Nitrogen
CH_4	89 %	Methane
C_2H_6	8 %	Ethane
C_3H_8	1 %	Propane
IC_4H_{10}	0.14 %	Isobutane
NC_4H_{10}	0.2 %	N-butane
IC_5H_{12}	0.007 %	Isopentane
NC_5H_{12}	0.001 %	N-pentane

COLUMN CP-SIL 5 CB 6 METER UNHEATED

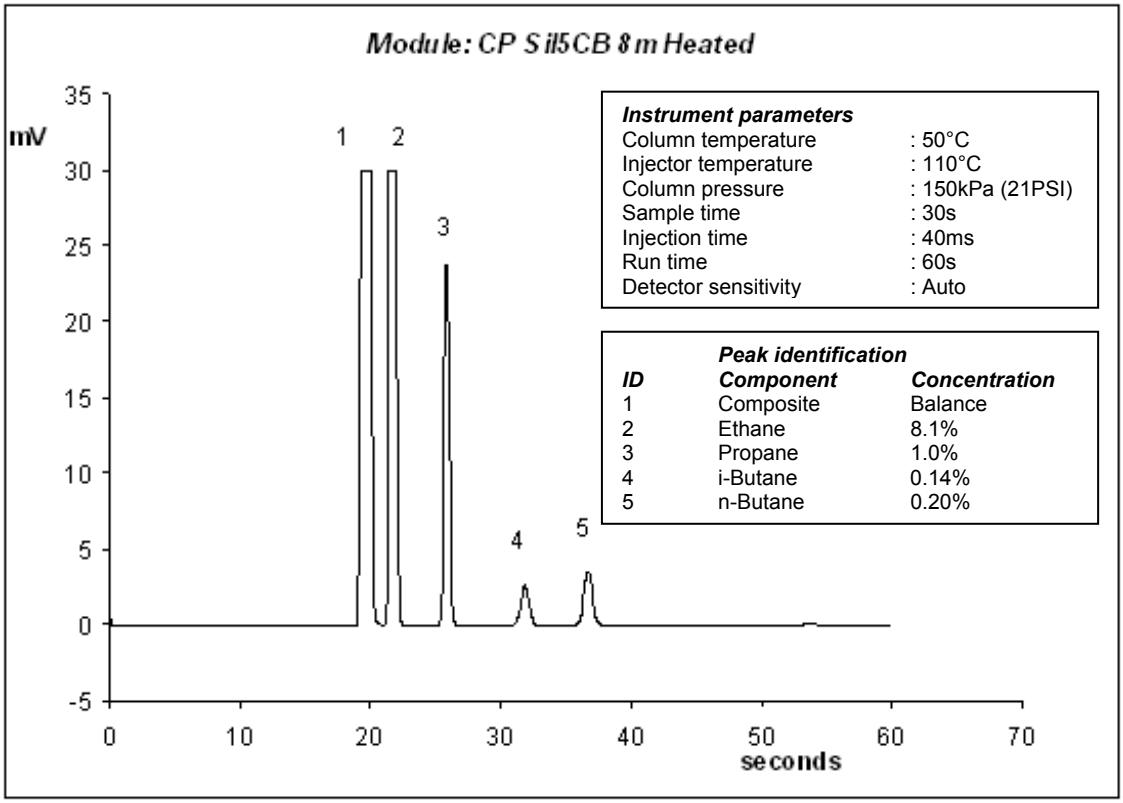


The natural gas components, mostly hydrocarbons, separate in the same order on the non-polar and medium-polar CP-Sil CB columns. Nitrogen, methane, carbon dioxide, and ethane are not separated on these columns. They produce a composite peak. For separation of these components a HayeSep A column is advised.

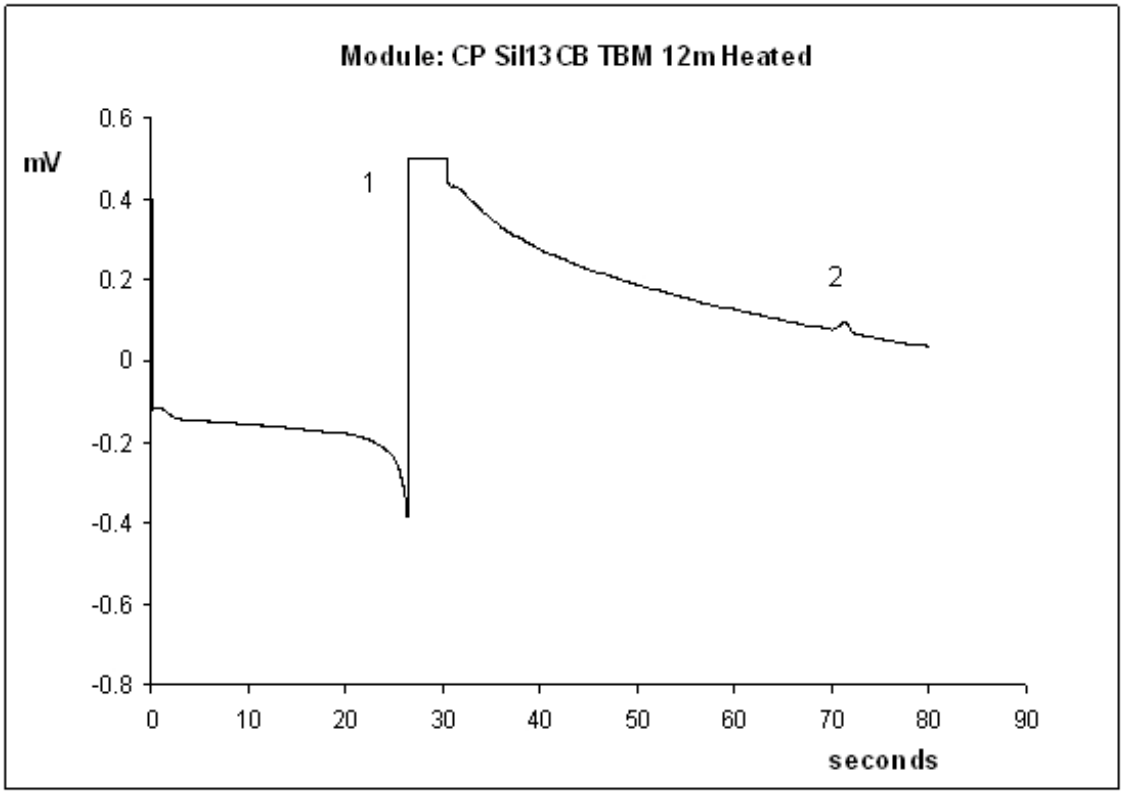
COLUMN CP-SIL 5 CB 4 METER HEATED



COLUMN CP-SIL 5 CB 8 METER HEATED



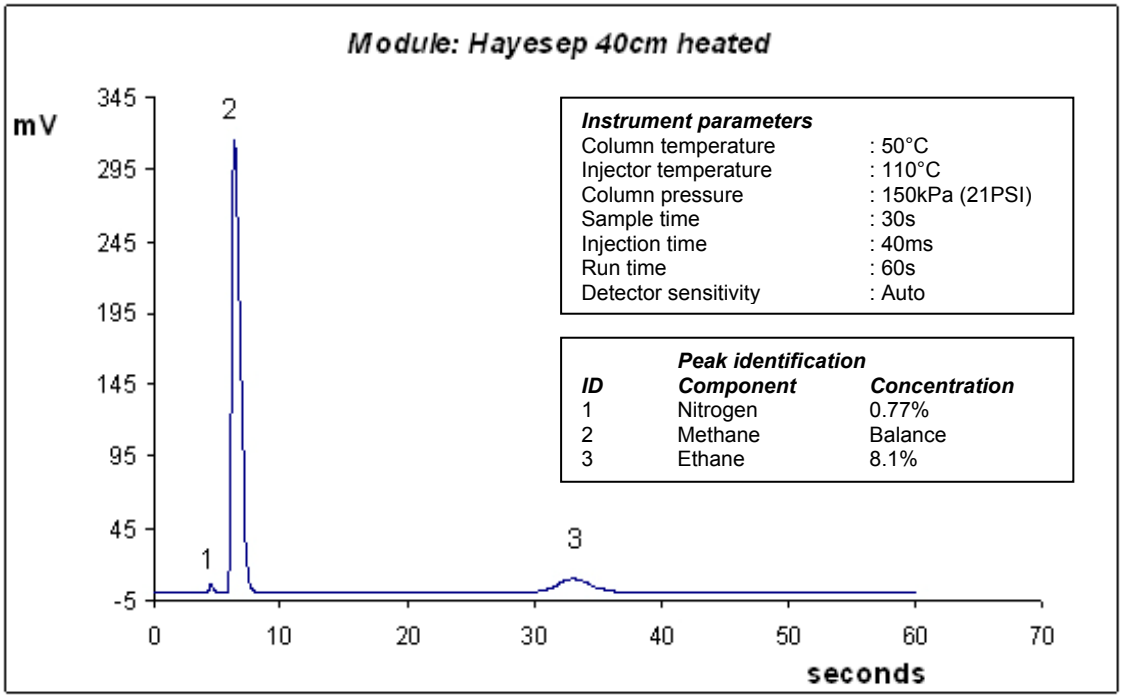
COLUMN CP SIL13CB TBM 12 METER HEATED



Instrument parameters	
Column temperature	: 40°C
Injector temperature	: 50°C
Column pressure	: 250kPa (38PSI)
Sample time	: 30s
Injection time	: 255ms
Run time	: 80s
Detector sensitivity	: Auto

Peak identification		
ID	***Component***	***Concentration***
1	Methane	Balance
2	TBM	6.5ppm

COLUMN HAYESEP 40CM HEATED

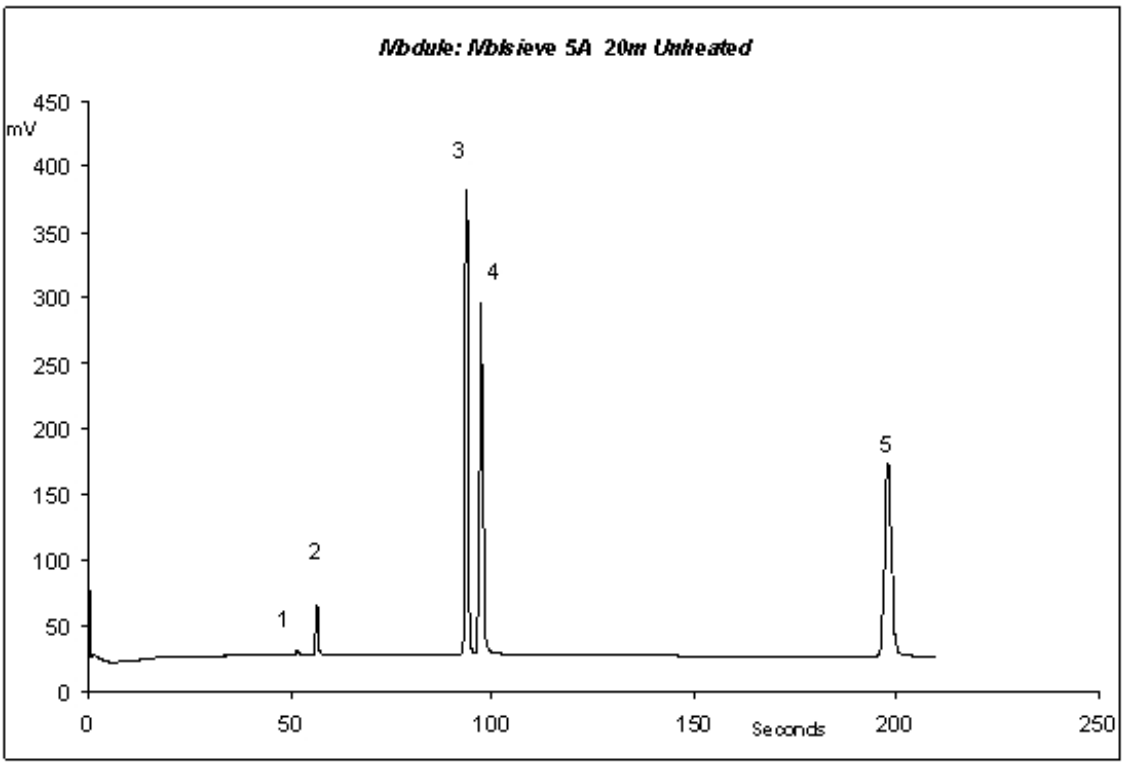


The HaySep A column separates oxygen, methane, carbon dioxide, ethane, acetylene, ethylene, and selected sulfur gases. Nitrogen coelutes with oxygen. Components with a higher molecular weight than propane have long retention times on this column.

CAUTION

Maximum allowable column temperature: 160 °C

COLUMN MOLSIEVE 5Å 20 METER UNHEATED



Instrument parameters	
Column temperature	: 40°C
Injector temperature	: NA
Column pressure	: 200kPa (28PSI)
Sample time	: 30s
Injection time	: 40ms
Run time	: 210s
Detector sensitivity	: Auto

Peak identification

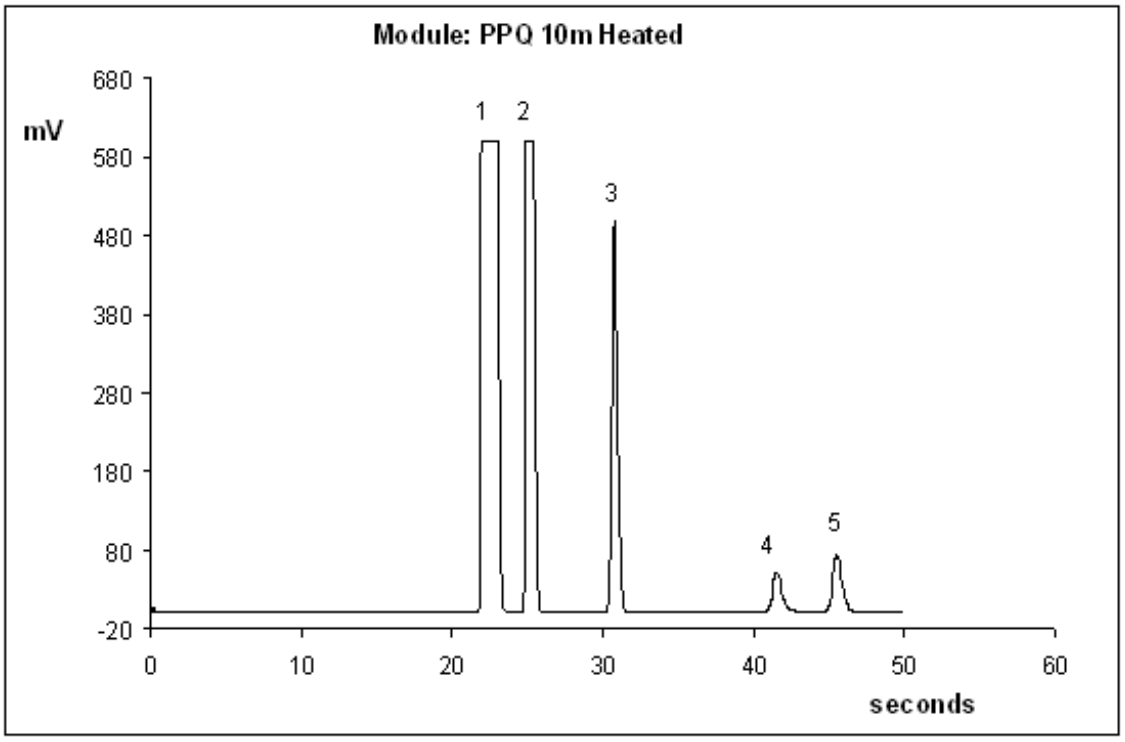
ID	***Component***	***Concentration***
1	Neon	18ppm
2	Hydrogen	1.0%
3	Argon	0.2%
4	Oxygen	0.2%
5	Nitrogen	0.2%

The Molsieve 5Å column is designed to separate: hydrogen, carbon monoxide, methane, nitrogen, oxygen, and some noble gases. Higher molecular weight components have much higher retention times on this column.

Conditioning of Molsieve columns

On a properly activated column nitrogen and oxygen will be very well separated. However, in time you will find that these two peaks will start to merge together. This is caused by water, present in the sample or carrier gas, adsorbing to the stationary phase. To restore the columns efficiency it will suffice to raise the oven temperature to 180 °C (max. column oven temperature) and, with the normal operating pressure on the column head, leave it to condition for about an hour. You are advised to switch the detector filaments off during this period. After reconditioning you can test the column performance by injecting plain air. If you have a proper separation between nitrogen and oxygen again the column separation power has been restored. If the Micro-GC's frequency of use is very high, you might adopt a standard reconditioning procedure of leaving the instrument with the oven temperature at 180°C overnight. The longer the re+onditioning period the better the column performance without damage.

COLUMN PPQ 10 METER HEATED



Instrument parameters	
Column temperature	: 150°C
Injector temperature	: 110°C
Column pressure	: 150kPa (21PSI)
Sample time	: 30s
Injection time	: 40ms
Run time	: 50s
Detector sensitivity	: Auto

	Peak identification	
ID	***Component***	***Concentration***
1	Composite	Balance
2	Ethane	8.1%
3	Propane	1.0%
4	i-Butane	0.14%
5	n-Butane	0.20%

REFERENCE

INSTRUMENT DESCRIPTION

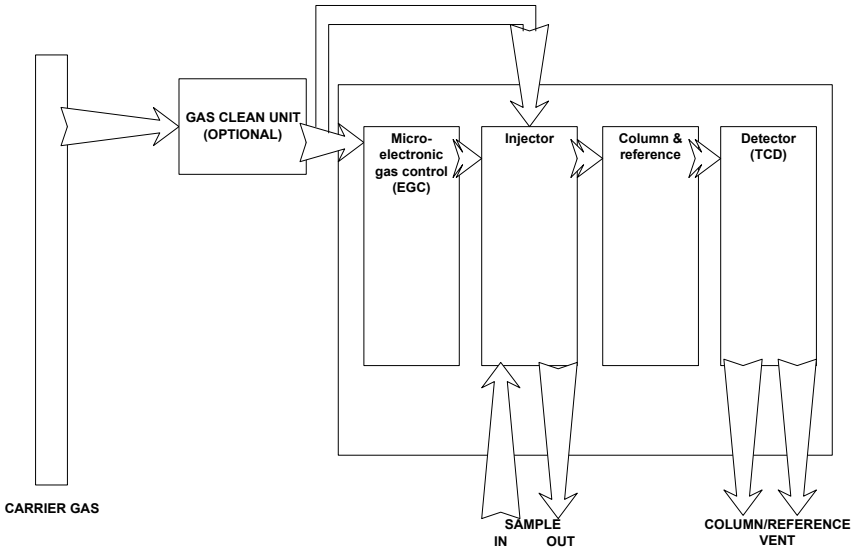
CARRIER GAS

The Varian, Inc. Micro-GC is configured for the use with either He (or H_2) or N_2 (or Ar).

Having chosen one option definitely rules out the use of the other without the instrument undergoing internal changes prior to any switching of carrier gas type.

It is recommended to use gases with a minimum purity of 99.995%. Since the injection valve is operated pneumatically, there is a limit of 550 kPa ± 10 % (80 psi ± 10 %) to the main gas supply.

Your Micro-GC is configured either for carrier gas He (or H_2) or it is configured for N_2 (or Ar). Use the carrier gas type, for which your instrument is configured, otherwise the detector filaments can be damaged.



MICRO ELECTRONIC GAS CONTROL (EGC)

The Micro-GC has built-in Micro EGC regulators that can be adjusted to get a constant or programmed pressure control, which result in a constant or programmed flow through the injector, column and detector. The pressure range of the Micro EGC is between 50-350 kPa (7 - 49 Psi). This pressure sets a continuous flow of carrier gas of about 0.2-4.0 mL/min.
A typical pressure rise is 200 kPa/min, which will give a significant pressure increase during the run, without excessive baseline disturbance. In most cases baseline subtraction may improve the quality of chromatograms that suffer from baseline drift.

INJECTOR

The injector has a built-in 10µl sample loop that is filled with the gaseous sample. The pressure of the sample should be between 0-100 kPa (0-15 psi) and the sample temperature within 5-40 °C ±5 °C of the analyzer.
By start “Run” within the data-handling package, a vacuum pump will draw the gas sample through the loop and then the injector will inject the gas sample from the sample loop into the gas stream. The minimum pressure required by the injector is 550 kPa ± 10 % (80 psi ± 10 %). A typical injection time is 40 milliseconds (ms). This equals an average injection volume of 200 nL. Injection time will be rounded to a multiple of 5 ms. A practical minimum value is 40 ms.

NOTE

In most cases a value of 0 - 20 milliseconds will result in no injection.

COLUMN

A variety of column configurations are possible on the Micro-GC . The columns you require for your specific analysis have been installed at our factory. Other configurations are, of course, possible, but changing the column modules is a delicate matter that can only be handled by one of our service engineers. Table I shows several standard columns as supplied in the Micro-GC and selected applications. Other columns are available by contacting Varian, Inc.

Column/Phase type	Target components
Molsieve 5Å	Permanent gases, methane, CO, NO ,etc.(H.R. for O2-Ar baseline separation). Optional Retention Time Stability (RTS) configuration
Hayesep A	Hydrocarbons C1-C3, N2, CO2, air, volatile solvents.
CP-Sil 5 & 8 CB	Hydrocarbons C3-C10, aromatics, organic solvents.
CP-Sil 19 CB	Hydrocarbons C4-C10, high boiling solvents, BTX.
CP-WAX 52 CB	Polar higher boiling solvents.
PLOT Al2O3/KCl	Light hydrocarbons C1-C5 saturated and un-saturated. Optional Retention Time Stability (RTS) configuration.
Pora Plot U	Hydrocarbons C1-C6, Freons, Anesthetics, H2S, CO2, SO2, volatile solvents.
Pora Plot Q	Hydrocarbons C1-C6, Freons, Anesthetics, H2S, CO2, SO2, volatile solvents.
CP-CO_X	CO, CO2, H2, Air, CH4.
THT column	THT and C3-C6 $^{+}$ in Natural Gas Matrix.
TBM column	TBM and C3-C6^{+} in Natural Gas Matrix.
CP-Poraplot	Specially tested for H_2S in natural gas (10 to 50 ppm)
MES column	Unique column specially tested for MES in natural gas (1 ppm)

For all compounds not present in this list contact you nearest Varian office

All columns except the HayeSep A (160 °C) and MES (110 °C) (TCEP) column can be used up to 180 °C, the maximum temperature of the column oven. The HayeSep A will deteriorate above 160 °C. Exceeding this temperature will cause the column to lose efficiency instantly and the column module will need replacement.

DETECTOR

TCD

The Micro-GC is equipped with a thermal conductivity detector (TCD). This detector responds to the difference in thermal conductivity between the carrier gas and the sample components. The construction of a TCD is such that the changing thermal conductivity of the carrier gas stream, due to components present, is compared to the thermal conductivity of a constant reference gas stream.

DMD

The Differential Mobility Detector, DMD, is fully integrated into a Analytical channel. Differential Mobility Detection is an advanced form of Ion Mobility Spectroscopy (IMS). It uses a drift tube under atmospheric and thermally constant conditions. See for more details chapter The difference mobility detector on page 39.

IN/OUTPUTS

The Micro-GC has several in/output ports accessible inside the instrument for interfacing with external devices.

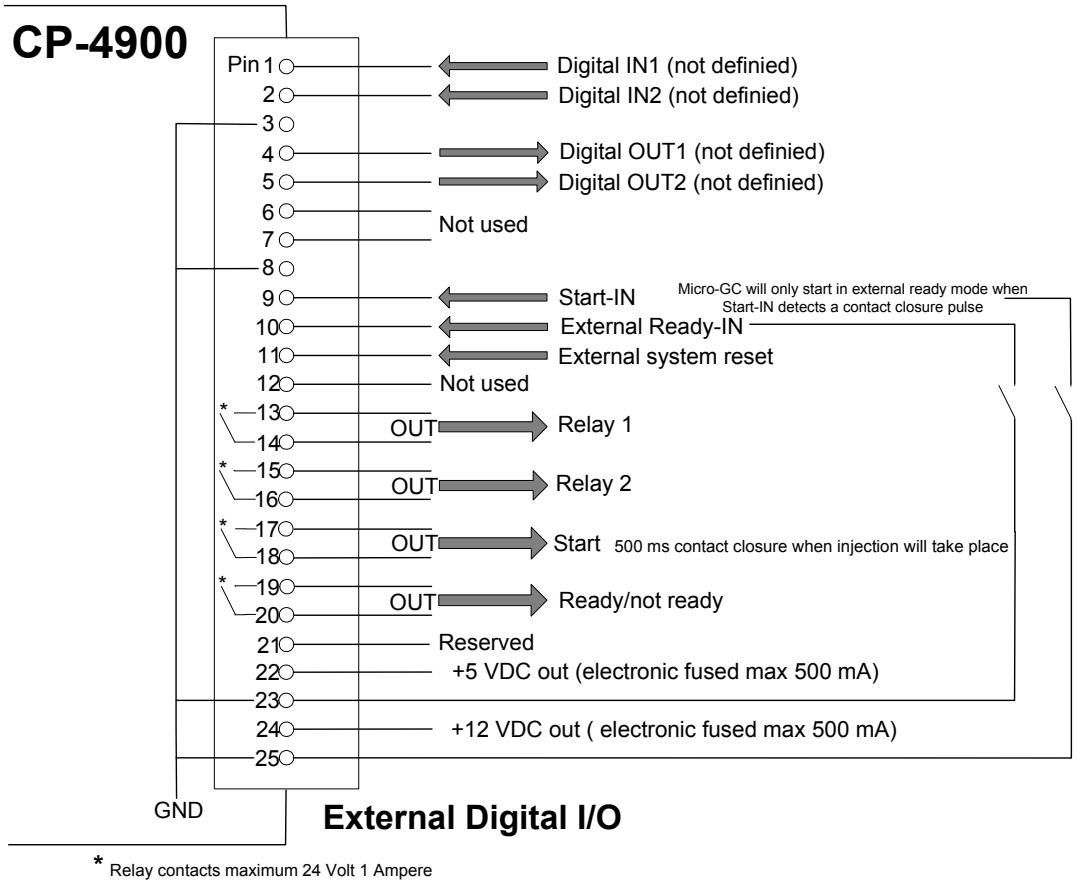
Open the cover.

At the front of the Micro-GC, the external device connectors will be visible.

NOTE **Close the cover after connecting the cables!**

EXTERNAL DIGITAL I/O

Connection between Micro-GC and external devices is made with the appropriate cable to the External Digital I/O port (see also External_devices on page 63).



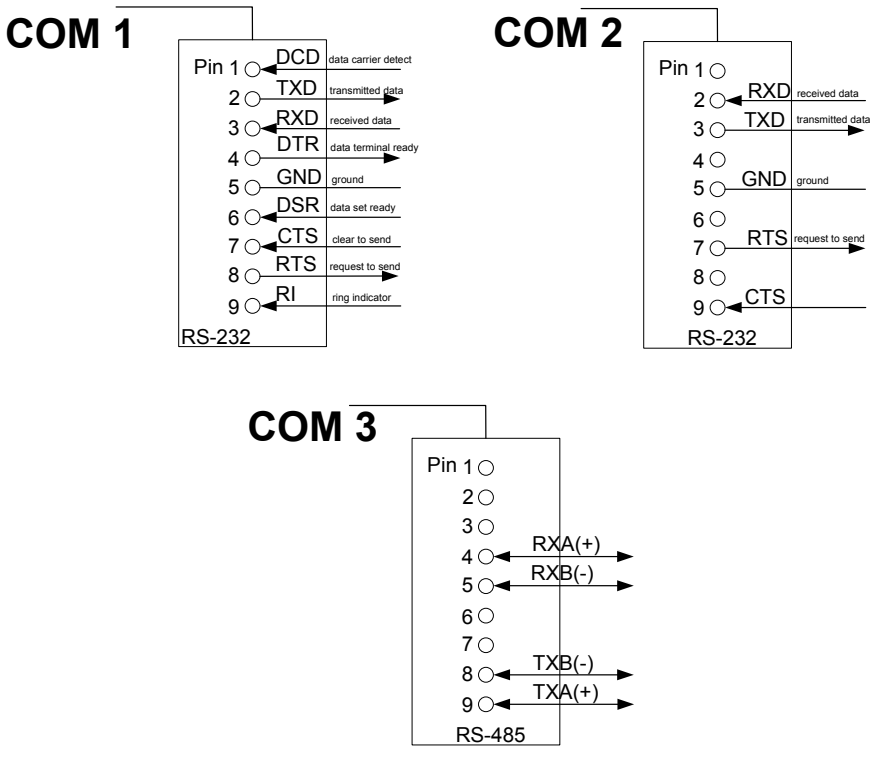
Ready/not ready signal

The Instrument Ready/not Ready output will follow instrument status (Ready LED in the front of the instrument).

COMMUNICATION PORTS (COM)

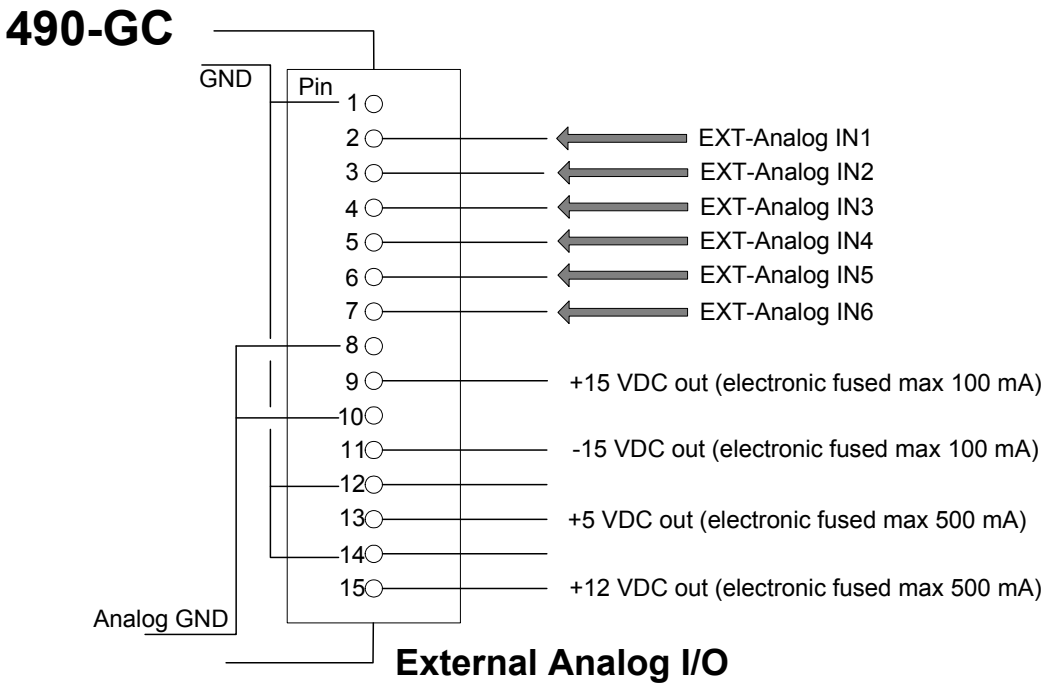
The instrument can communicates serially with the computer via an RS-232 port (COM 1) accessible inside the instrument. (see also Serial communication on page 49). In the table below an overview is given of the communication possibilities.

Function	*Galaxie (Standard)*	*EZchrom*
COM 1	-	RS-232-interface
COM 2	RS-232-interface	RS-232-interface
COM 3	RS-485-interface	RS-485-interface
Ethernet	10Mbit	10Mbit
Video output	VGA (not used)	VGA (not used)



EXTERNAL ANALOG I/O

This external analog I/O port can handle six (6) analog inputs (input 0-10 Volt)
The User Interface receives this analog information, and translates this information into actions to be taken by the local user interface and/or events/data to be shown/stored in the remote user interface (see also External_devices on page 63).



THE DIFFERENTIAL MOBILITY DETECTOR

GENERAL

WARNING:
RADIATION SOURCE

This detector contains a Ni^{63} beta-emitting radioactive isotope plated onto a metallic foil for ionization of the carrier gas.

For details about procedures governing the handling, leak testing, repair, storage, shipping and maintenance of records for the Ni^{63} DMD detector as a radioactive sealed source please refer to the Ni^{63} Radiation Safety Manual.

General functionality

Varian has extended its Micro Gas Chromatography product line with a new detector. The Differential Mobility Detector, DMD, integrated into the chassis is a joint development of Sionex Corporation and Varian Instruments.

Differential Mobility Detection is an advanced form of Ion Mobility Spectroscopy (IMS). It uses a drift tube under atmospheric and thermally constant conditions. The advantage over IMS is that DMD uses additional sets of RF modulation voltages, which results in selective performance, which is tuneable depending on the compounds of interest and the matrix.

Ions generated by a Ni63 radioactive ionization source are transported through a drift tube by means of a high velocity transport gas, usually Zero-Air or Nitrogen. The drift tube basically consists of two parallel plates, approximately 500 microns apart. Over these plates a RF modulated electric field is applied by setting a fixed Voltage of 2-500 Volts/cm and a Scanning Voltage (or Compensation Voltage). The RF modulation frequency is 1.3 Megahertz.

Isolation results from the interaction between the ion and the net applied field that alternates between high and low electric field strength. Trajectory of the target ions will be tuned so that the ions of interest straight through the filter without colliding with the electrode plates, when they would be neutralized and not detected. The Compensation Voltage is used for ‘tuning’ the trajectories of ions in order to get the ‘desired’ ions towards the detector.

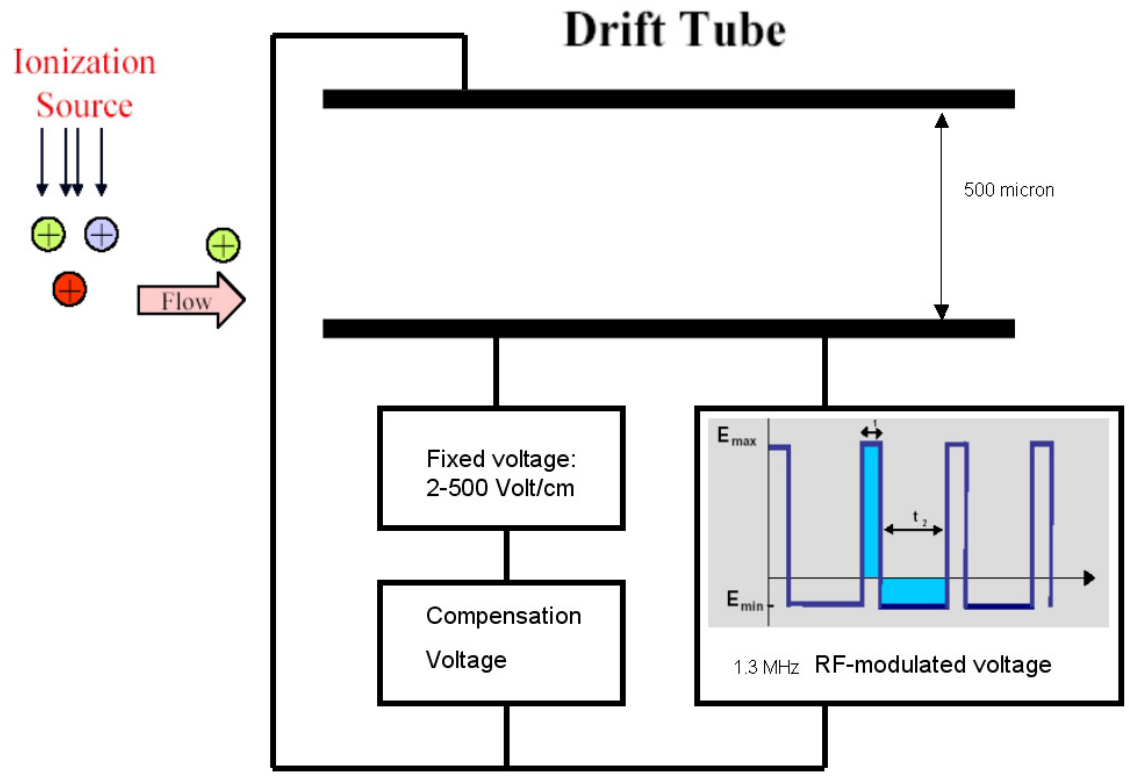


Figure: DMD set-up showing different voltages applied.

As illustrated in Figure 1, the net voltage applied results from three independent settings:

1. A fixed voltage, or RF-Voltage,
2. A scanning voltage, also referred to as Compensation Voltage,
3. A RF modulated voltage.

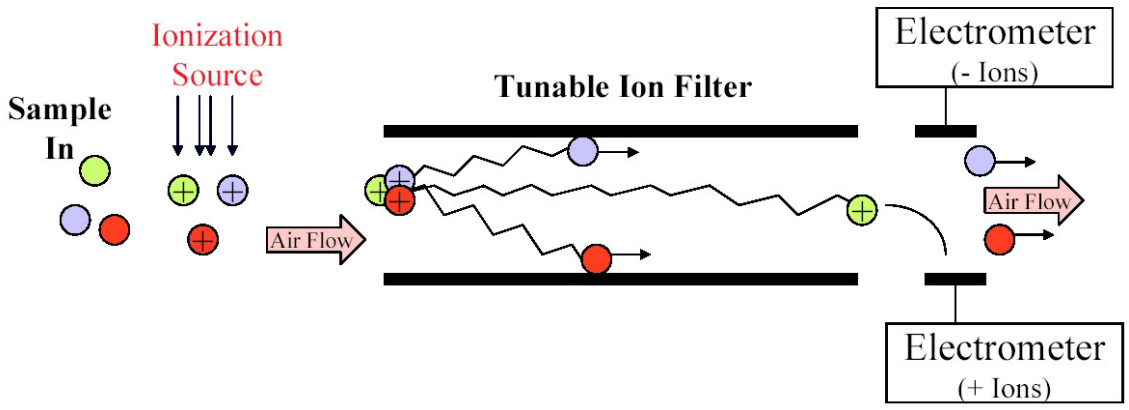
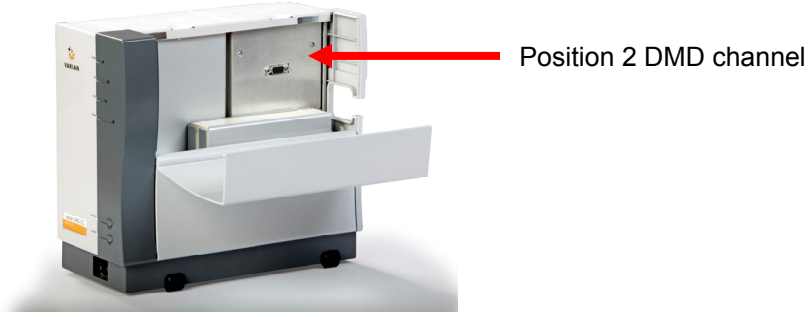


Figure 2:Separation principle of DMD

As illustrated in Figure 2, the DMD is equipped with two detectors, one for positive ions and one for negative ions. Yet, the data produced by the DMD show a 'normal' two-dimensional representation as the system will be 'tuned in time' to detect certain species by setting compensation voltages to accommodate transmission of the compound of interest in that particular part of the chromatogram. This 'time-segmented' detection thus leads to maximum selectivity for the application of interest as the matrix is eliminated. The application specific method is saved inside the DMD hardware.

Micro-GC DMD Channel

The DMD channel is always located in the last position (against the backpanel)



The firmware recognises the DMD channel as a detector only, and automatically sets the controls accordingly.

A complete instrument, the DMD consists of a basic cabinet, a column module with its pneumatic system, its standard µ-TCD and an additional DMD. The standard channel's µ-TCD output is in series with the DMD inlet via a heated transfer line. The temperature of this heated transfer line is controlled from the DMD electronics.

From a control point of view, the DMD has no control of a column temperature or column head pressure or the optional injector temperature as needed for the GC channel. No carrier gas type needs to be selected in the configuration.
Furthermore, the DMD method is factory tuned and ready to perform the appropriate application. This requires the Micro-GC method to be identical throughout its use with respect to chromatographic column and settings.

GENERAL OPERATION

Within the workstation package, the DMD will be handled as a separate channel. With respect to the operation of the DMD note the following:

- In instrument configuration, selection of carrier gas type and heated injector has been removed.
- In method development for the DMD channel, GC-channel specific information has been left out. Instead, the Transfer line temperature and the detector tuning capabilities are added.
- In instrument status for the DMD channel, GC-channel specific information has been left out. Instead, the Transfer line temperature and the detector tuning capabilities are added.

Tuning the DMD

The complete DMD method for the instrument specific application has been tested and is loaded inside the DMD. Generally no modification or changes are required in case the factory-supplied method is used throughout.

In case of a suspected misalignment of the method, where retention time or compensation voltage may be out of tune, a tuning run may be needed.

Please contact for more information your local Varian Inc. subsidiary or Varian, Inc. representative.

PROTOCOLS

A protocol is a set of rules that govern how computers send and receive information.

Different Types of Protocols:

AppleTalk, ATM, Banyan Protocols, CDPD, DECnet Protocols, Frame Relay, ***GPRS***, H.323, IBM Protocols, ***ISDN***, ISO Protocols, LAN Data Link Layer Protocols, MPLS Novell Protocols, PPP Suite, Bridge/Router Internetworking Protocols, SNA, SS7 Suite Sun Protocols, Tag Switching Protocols, ***TCP/IP Suite, UMTS Telephony***, V5, Voice over IP#(VoIP), WAP, X.25, XNS

The Internet Protocol Suite

- Developed to allow cooperating computers to share resources across a network.
- TCP and IP are the two best-known protocols in the Internet Protocol Suite.
- Other protocols / services are FTP, Remote Login (Telnet), Mail, SMTP.

IP Addresses

- Uniquely identify a computer on the Network / Internet.
- Are made up of four 8-bit numbers and each of these numbers are separated by a point.
- Each of the 8-bit numbers can represent a decimal value of 0-255.
- Each part of an IP address can only be in that range (e.g., 198.12.253.98).

The Internet protocol suite

Starting IP	***Ending IP***	***Subnet Mask***	***Type***
0.0.0.0	255.255.255.255	N/A	Public
10.0.0.0	10.255.255.255	255.0.0.0	Private
172.16.0.0	172.31.255.255	255.255.0.0	Private
192.168.0.0	192.168.255.255	255.255.0.0	Private

Note: never use 0.0.0.0. or 255.255.255.255

MICRO-GC AND NETWORKS

Network Requirements of the Micro-GC

- Customer Cable type should be Cat3 or Cat5 UTP / STP.
- Customer network should comply with Standard Ethernet (IEEE 802.3).
- The network must have either 10BASE-T or 10/100BASE-TX compatible HUB or Switch.
- TCP-IP should be used on the network.

FAQ (FREQUENT ASK QUESTIONS)

Q: Can I connect the Micro-GC to my Network?
A: Yes, if the network is standard Ethernet and uses TCP-IP with UTP cabling.

Q: I'm using a DHCP server; can I use this to assign the GC with an IP-Address?
A: No, The GC works with static IP-addresses only, so an IP-address will have to be reserved on the DHCP server and marked as static.

Q: How do I assign the GC with an IP-address?
A: Connect the GC via a UTP crossover cable to the pc running Workstation software. Then define the network-settings, and restart the GC with the Service button pushed.

Q: Are the network settings saved if the GC is restarted, or with loss of power?
A: Yes, the Network Settings of the GC are stored in Flash Memory, and will not be erased at loss of power.

Q: Can I control my Micro-GC from anywhere in the world via the Internet?
A: Yes, if the customer network is designed for this, and has Internet access or remote access facilities (the ports 4900,4901 and 4902 must be open).

GLOSSARY OF NETWORK TERMS

The following brief glossary of terms may be useful:

BNC connector
This is a bayonet style connector used for a two-conductor style hardware connection. BNC connectors are used with the CP-3800 GC.

Crossover Cable
A cable is used to connect two, and **only two**, Ethernet devices together.

Domain
This is one of several settings that reside within the TCP/IP configuration that identifies paths that are used to establish connections with Ethernet devices. The Domain is an IP address.

Ethernet Address
This is a unique identifier that every Ethernet communication device has assigned to it. Typically, the Ethernet address cannot be changed and is the permanent way of identifying a particular hardware device. The Ethernet address consists of 6 pairs of hexadecimal digits.

Gateway
This is one of several settings within the TCP/IP configuration that identifies paths that are used to establish connections with Ethernet devices. The Gateway is assigned an IP Address.

Host name
The host name is an alternate way of identifying a device that is friendlier to people. Frequently the host name and the IP address may be used interchangeable.

Hub
A device that allows many Ethernet devices to be interconnected. Several hubs may be interconnected to increase the number of Ethernet connections. For 10Mbits/second network connections (10BaseT), no more than four (4) hubs may be connected in series. For 100M bits/seconds network connections (100BaseT), no more then two hubs may be connected in series.

IP Address
This is a unique number for each Ethernet device within the set of connected devices. Two PCs may have identical IP addresses so long as they are not interconnected to each other either through the Internet. The IP Address consists of a series of four sets of decimal numbers (between 1 and 255) that provide routing information used by the TCP/IP protocol to establish a reliable connection. Without the IP Address, communications would be bogged down trying to establish connections to Ethernet addresses at unknown locations.

Patch Cable
A cable that is used to connect Ethernet devices to hubs, switches, or your company network.

RJ45 Connector
This is a telephone jack style connector used for a Universal Twisted Pair (UTP) hardware connection for 10/100BaseT Ethernet connections.
RJ45-style connectors are used by the Micro-GC.

TCP/IP
An international standard protocol used by the Internet. We use this protocol for communication to the Micro-GC. You may find several network protocols, such as IPX/SPX and NetBEUI, installed on you computer.

Workstation software

For detailed driver information visit the help-file(s) in the used Workstation software.

	EZChrom Elite	Galaxie
Communication	Ethernet and RS232	Ethernet only
IP Settings	BootP/RS232	BootP/RS232
Com 1	RS232	Not available
Com 2	Stream selection on Com-2	Stream selection on Com 2 *
Com 3	Not available	Not available
Analog I/O	Capturing	Yes (via Analog Board)
Digital I/O	External start in: Yes External Ready: Yes	External start in: Yes External Ready: Yes
Relay Control	Timed Relay: Yes Alarm Relay: Yes	Timed Relay: Yes Alarm Relay: Yes

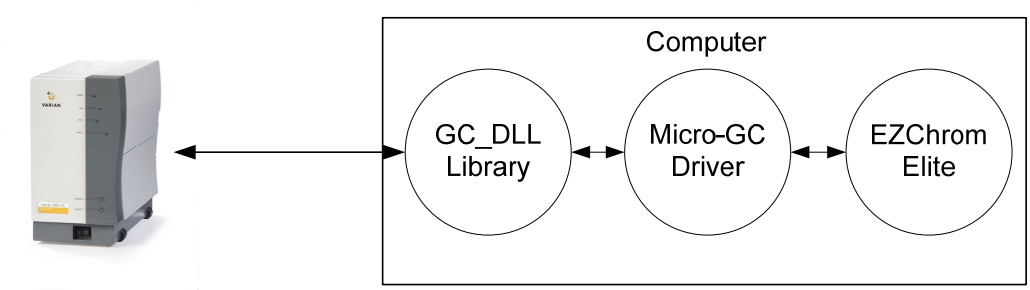
* Only one Vici valve possible in Galaxie

EZCHROM ELITE

Multiple Micro-GCs can be controlled serial or Ethernet.

The maximum number of Micro-GCs controlled by (one computer) serial communication is two. For Ethernet this is limited by your license.

The 490-GC driver scope



CONTROL INSTRUMENT

Ethernet control on page 50 (TCP/IP) is standard.

Even if the instrument is equipped with Ethernet it is possible to control the instrument serially. In that case the instrument will accept the first incoming connection type (serial or Ethernet) and will lock the other connection type. There can never be a connection on the two different ports at the same time.

SERIAL COMMUNICATION

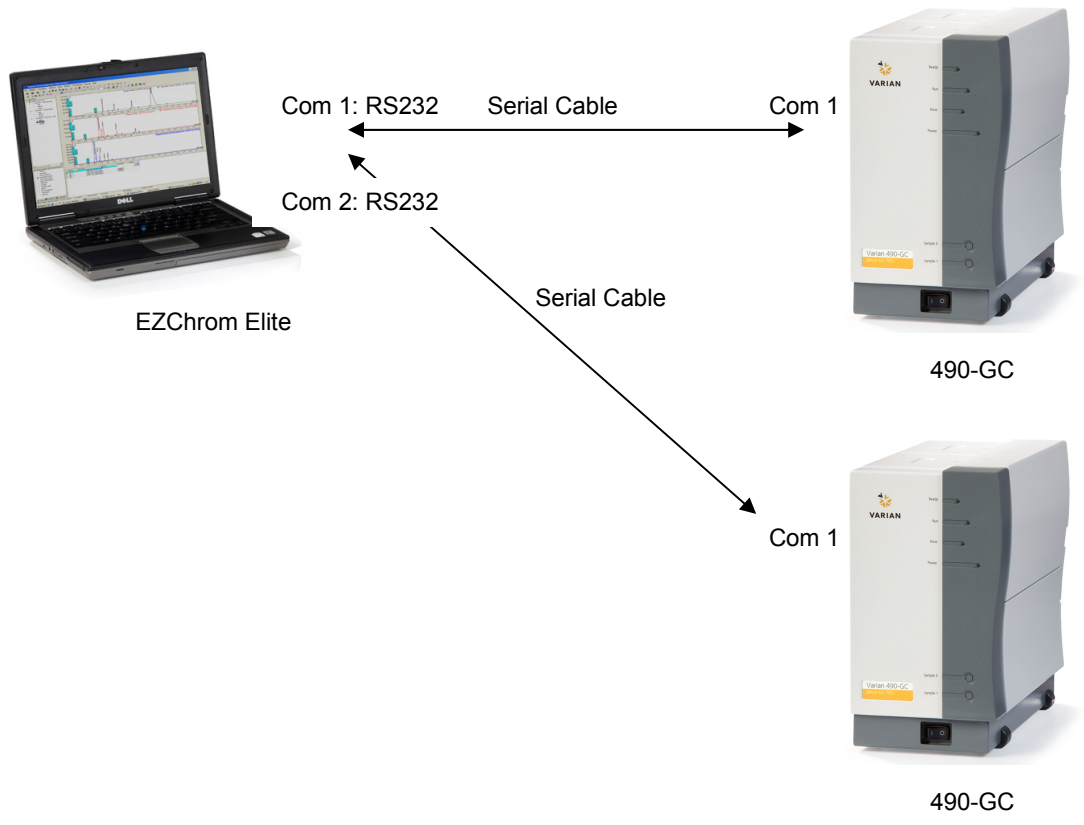
To control the Micro-GC via serial communication, just connect the serial cable (supplied with the instrument) to a free serial port of your computer configured as RS232, and plug the other side into port COM 1 of the Micro-GC (see Inside View on page 14).

NOTE

Avoid cable lengths longer than 15 meter while this can cause communication problems due to high communication speed (baud rate 115200 bits/sec).

NOTE

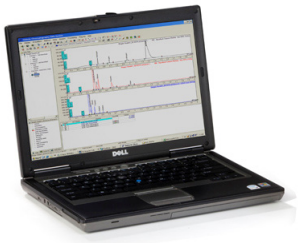
The maximum number of Micro-GCs controlled by serial communication is two. Choose Ethernet communication in case more than two Micro-GCs must be controlled by one computer or setup a second computer with EZChrom Elite installed. If RS485 is required, an RS232-RS485 converter (optional) must be used. RS485 is only possible via two RS232-RS485 converters, one on Workstation (computer) side and either one at Micro-GC side on Com 1.



ETHERNET COMMUNICATION

An Ethernet crossover cable (RJ-45 connector, 2.8 meter) is included with the Micro-GC.
The crossover cable must be used to control the Micro-GC in a peer-to-peer communication (see Inside View on page 14).
This requires IP addresses in the same range for computer and Micro-GC. Only the most right IP segment must be different.
In case both the computer as well as the Micro-GC are connected to a (local) network this cable cannot be used for control of the Micro-GC.
However this crossover cable must be used if a new IP address has to be assigned to the Micro-GC. Once the IP address is assigned you can disconnect the crossover cable and connect computer and Micro-GC both to a (local) network.

Peer-to-peer: single instrument

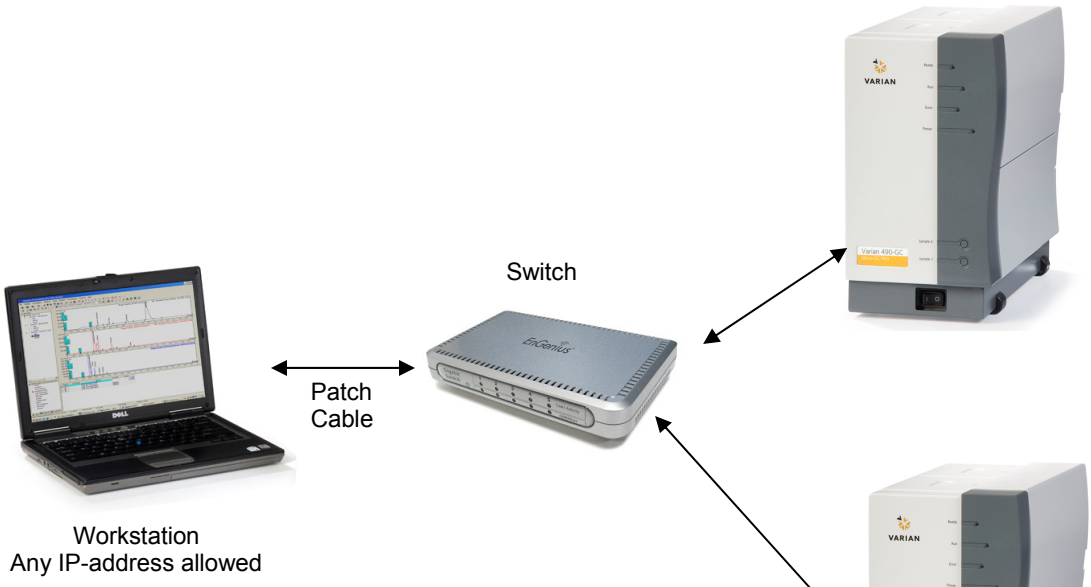


Crossover Cable

Workstation
Any IP-address allowed

490-GC
Multiple 490-GCs connected to a local workstation. IP-address in same range as computer IP-address.

Multiple instrument (local network)

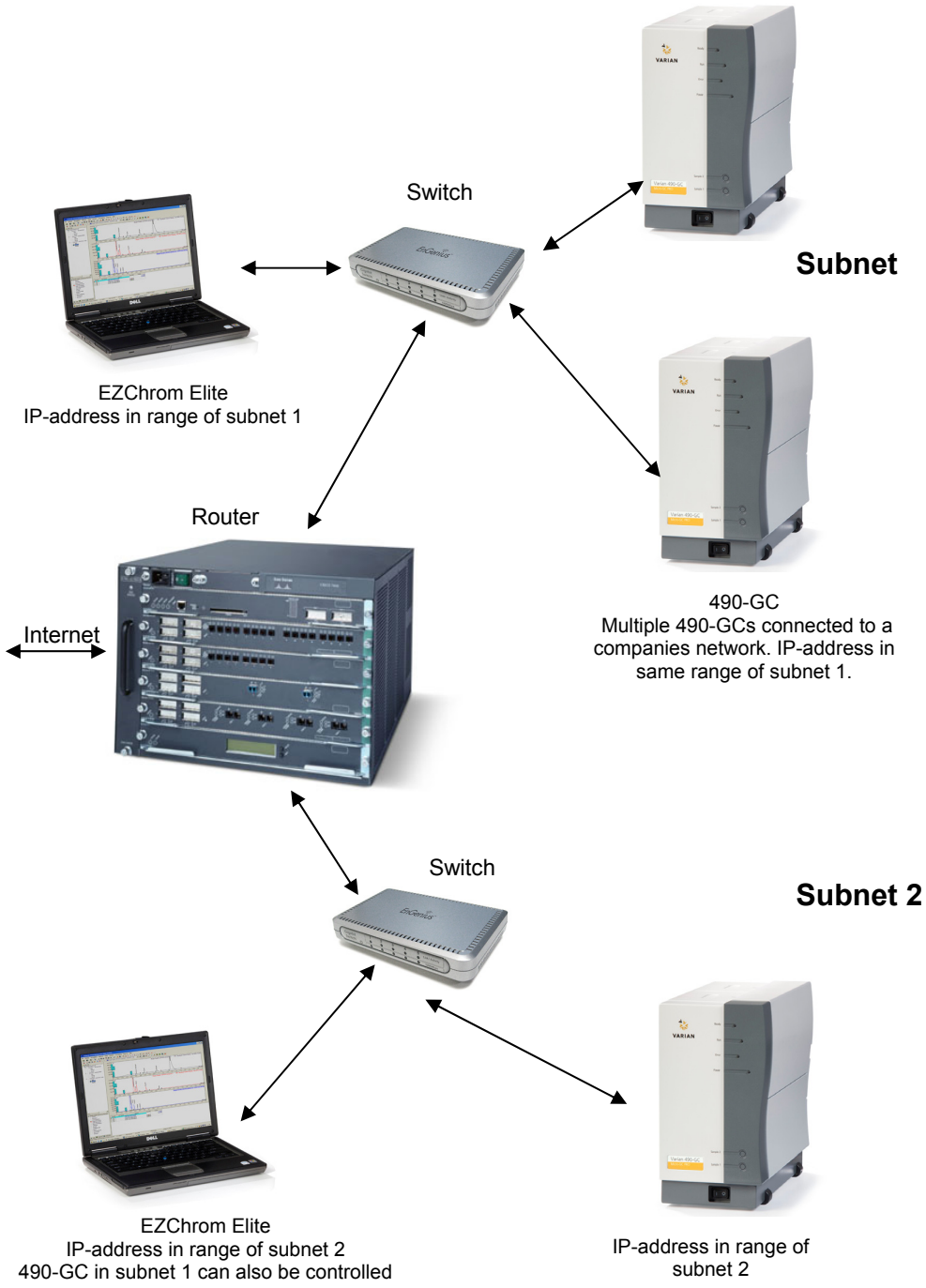


Workstation
Any IP-address allowed

EZChrom Elite maximum connections are limited by the computer speed, license and network performance.

490-GC
Multiple 490-GCs connected to a local workstation. IP-address in same range as computer IP-address.

Global network: Multiple instruments

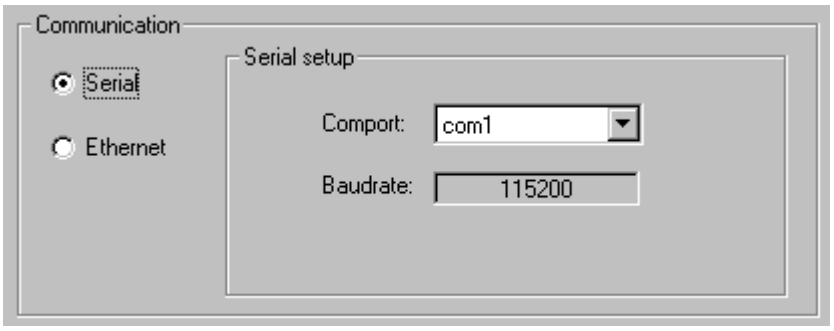


COMMUNICATION SETUP

In the Workstation window select the type of communication for instrument control.

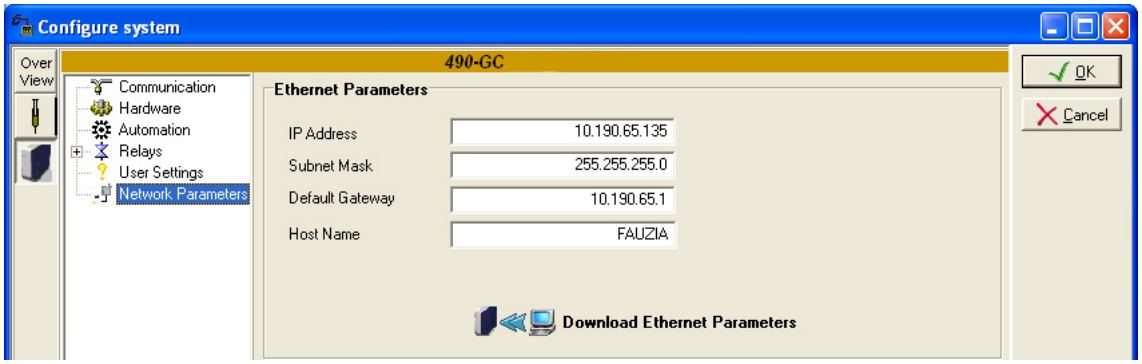
Serial communication (EZCrom only)

For serial communication select a free serial port on your computer which is configured as RS232. You need an RS485-RS232 converter to control the instrument via RS485. Com1 on the Micro-GC is fixed configured as RS232. The baud rate is fixed at 115200 bit/sec.



Ethernet communication (Galaxie)

For Ethernet communication select “Configure system”, followed by the “Network Parameters” in order to setup the IP address for the instrument. If the IP address is already known (and in the right subnet range) only the IP address has to be typed in. It’s also possible to change the IP address (Assign new IP address on page 54) with BootP and to view all the Micro-GCs connected to the subnet.



ASSIGN NEW IP ADDRESS VIA ETHERNET CONNECTION

If for the network the Micro-GCs IP address is unknown or invalid, a new IP address must be assigned.

To assign a new IP address the following steps are required:

1. Make sure the computer and the Micro-GC are connected to the same subnet or use the supplied Ethernet crossover-link cable to connect computer and Micro-GC (peer to peer connection).

2. Setup the IP address for the computer in case the computer wasn't connected to a network before. For a global network, the system administrator must be contacted.

3. Enter the IP address that must be assigned to the Micro-GC. This IP address must be in the same range as the computers IP address. The three left IP segments must be identical.

4. Enter the Subnet Mask. This will be in most cases 255.255.255.0.

5. Enter the Gateway IP address if this is required. In most small local network this is not required.

6. Enter the Domain if this is required. In most local network this is not required.

7. Enter a Host name for the Micro-GC.

8. Do now reboot the Micro-GC in the assign IP-address mode. Hold down the push button located just above the Ethernet RJ-45 connector in the Micro-GC on page 14 and power up the Micro GC. Hold down this button till the instrument is started. This will take approximately 1 minute. The Micro-GC is now in assign IP-address mode and starts broadcasting on the net "Waiting for IP address assignment". There is a BOOTP/DHCP server running in the Micro GC when it is started in service mode.

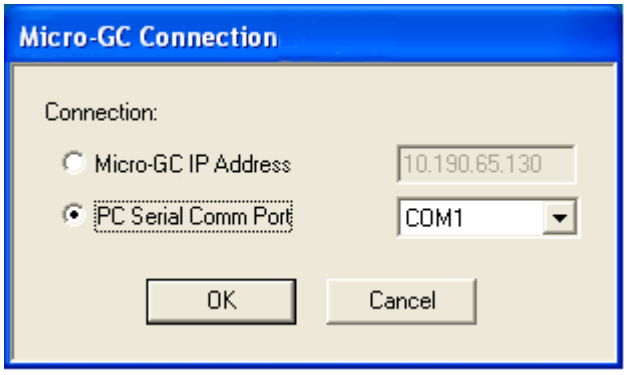
9. Press now the "Assign IP address" button. The Micro-GC driver does now assign the defined IP address to the first received BOOTP/DHCP request. This will take maximally 2 minutes.

10. Switch the Micro-GC off and then on again (Reboot).

Never startup two Micro-GCs in the assign IP-address service mode at the same time. This to avoid assigning an IP address to the wrong Micro-GC.

ASSIGN NEW IP ADDRESS VIA SERIAL CONNECTION

1. Make sure this computer and the Micro-GC are connected via a serial RS232 cable (peer to peer connection).
2. Start the Micro-GC configuration in Serial mode (see communication setup) on page 53
3. Click on the button “Serial Setup IP-address”, the “Serial Setup Ethernet Settings” window appears.
4. Enter the IP address that must be assigned to the Micro-GC. This IP address must be in the same range as the computers IP address. The three left IP segments must be identical.
5. Enter the Subnet Mask. This will be in most cases 255.255.255.0.
6. Enter the Gateway IP address if this is required. In most small local network this is not required.
7. Click now on the button “Assign IP address” of the “Serial Setup Ethernet Settings” window.
8. Switch the Micro-GC off and then on again (Reboot).
9. Change the Micro-GC configuration from Serial mode to Ethernet mode and proceed as described in the section Ethernet communication on page 50.



REMOTE ACCESS INSTRUMENT STATUS

The Instrument status of the Micro-GC can be accessible for other applications like Varian userlink applications: Mlink32, I/O Control, PCI1000Com or any other self written program capable to collect instrument status from the UserDataStore database.
It is required that this application runs on the same computer together as EZChrom-Elite. Read the user-manual of Mlink32, I/O Control or PCI1000Com in order to import the instrument status into these applications. Find more information in topic Varian Userlink applications. on page 60.

To enable remote access of instrument status, select a unique “Instrument” number and “Remote Access status” In the Automation Tab of the Instrument Configuration.

The following instrument status parameters are available for other applications running:

UserDataStore Address	Parameter description
1200	Serial number Main board
1201	Serial number Channel 1 Controller
1202	Serial number Channel 2 Controller
1203	Serial number Channel 3 Controller
1204	Serial number Channel 4 Controller
1205	Serial number Channel 1 Analytical Module
1206	Serial number Channel 2 Analytical Module
1207	Serial number Channel 3 Analytical Module
1208	Serial number Channel 4 Analytical Module
1209	Part number Channel 1 Analytical Module
1210	Part number Channel 2 Analytical Module
1211	Part number Channel 3 Analytical Module
1212	Part number Channel 4 Analytical Module
1213	Reserved for Tx com2 Don’t use this
1214	Reserved for Tx com3 Don’t use this
1215	Reserved for Rx com2 Don’t use this
1216	Reserved for Rx com2 Don’t use this
1218	Instrument State (0=Initializing, 1=Flushing, 2=Running, 3=Stabilizing, 4=Ready, 5=Error, 6=Recovery error, 7=Broken, 8=Not ready)
1219	Instrument general Error State. Find error description in next table
1220	Error State
1221	Sample Line temperature in Celsius
1222	Ambient pressure in kPa
1223	Ambient temperature in Celsius
1224	Power Supply in Voltage
c1226	Auto Sampler position
1227	Auto Sampler position at start of run
402	Current stream position

1230	Instrument external Ready-In state
1231	External Analog Input #1 in units determined by the scaling and offset factors
1232	External Analog Input #2 in units determined by the scaling and offset factors
1233	External Analog Input #3 in units determined by the scaling and offset factors
1234	External Analog Input #4 in units determined by the scaling and offset factors
1235	External Analog Input #5 in units determined by the scaling and offset factors
1236	External Analog Input #6 in units determined by the scaling and offset factors
1237	External Analog Input #1 at start of run (copied from address 1231)
1238	External Analog Input #2 at start of run (copied from address 1232)
1239	External Analog Input #3 at start of run (copied from address 1233)
1240	External Analog Input #4 at start of run (copied from address 1234)
1241	External Analog Input #5 at start of run (copied from address 1235)
1242	External Analog Input #6 at start of run (copied from address 1236)
1243	Column temperature channel 1 in Celsius
1244	Column temperature channel 2 n Celsius
1245	Column temperature channel 3 n Celsius
1246	Column temperature channel 4 n Celsius
1247	Injector temperature channel 1 in Celsius
1248	Injector temperature channel 2 in Celsius
1249	Injector temperature channel 3 in Celsius
1250	Injector temperature channel 4 in Celsius
1251	Column pressure channel 1 in kPa
1252	Column pressure channel 2 in kPa
1253	Column pressure channel 3 in kPa
1254	Column pressure channel 4 in kPa

GENERAL ERROR STATE

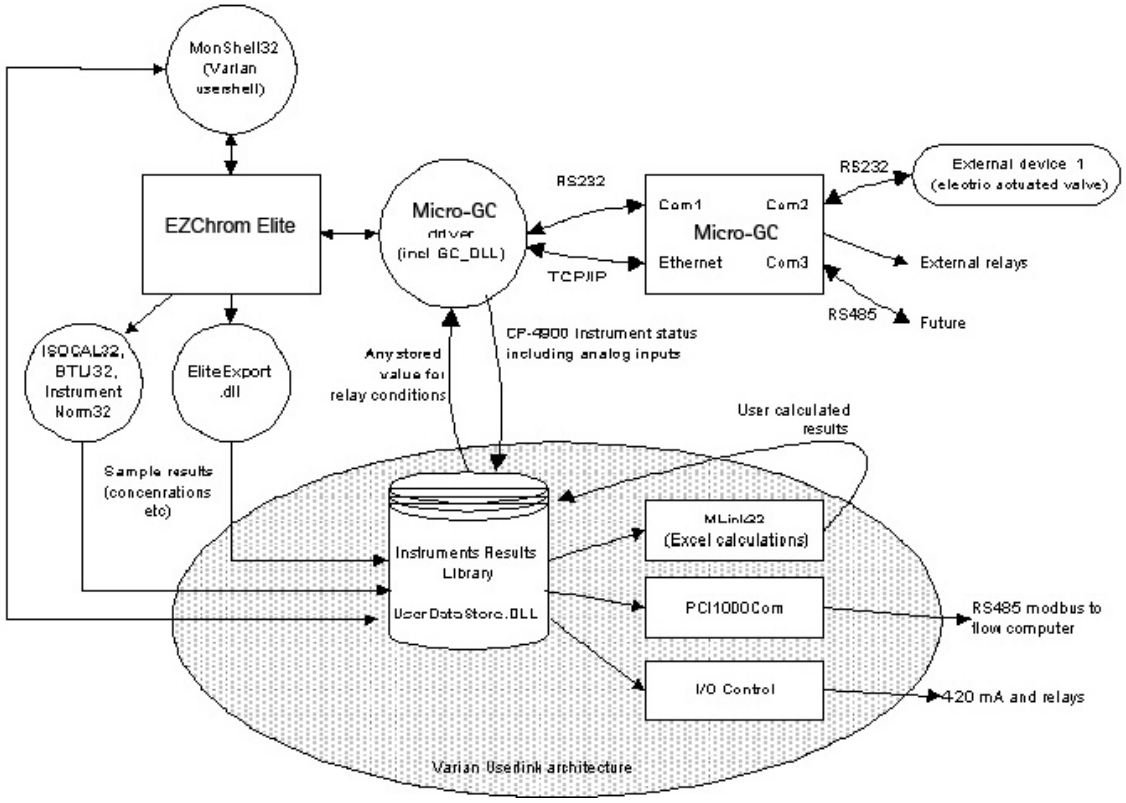
The General Error State as stored in UserDataStore address 1219 is composed of the following items:
The error must be handled as 'CLNNN' in which C=error class, L=location and NNN=error number or event number.
The Error class contains of the following values: 0=diagnostic error, 1=advisory error, 2=critical error, 3=fatal error.
There are five locations: 0=main board, 1=channel 1, 2=channel 2, 3=channel 3 and 4=channel 4.

Error number NNN	Error Description
1	Init passed (event)
2	Pressure restored
3	Start flush cycle
4	Flush cycle passed
5	TCD calibrating
6	Too low pressure
7	Pressure fault
8	Low battery 1
9	Low battery 2
10	Sample line sensor fault
11	Sample line temperature fault
12	Injector temperature fault
13	Column temperature fault
14	TCD Temperature limit activated
15	EDS logging error
16	Low power supply
17	Injector sensor fault
18	Column temperature sensor fault
19	TCD control error
20	TCD calibration failed
21	Hardware reset"
22	Pressure too high
23	Initialization error
24	Internal communication error
25	Instrument EDS incorrect
26	EDS incorrect
27	Internal power failure
28	Flush cycle aborted
29	GC module changed
30	TCD Gain calibrated
31	TCD Offset calibrated
32	Null String

33	ADC reading out of range
34	EDS Analytical Module incorrect
35	EDS Config checksum incorrect
36	EDS Logbook checksum incorrect
37	EDS Protected checksum incorrect
38	EDS C.C. Config checksum incorrect
39	EDS C.C. Logbook checksum incorrect
40	EDS C.C. Protected checksum incorrect
41	EDS A.M. Config checksum incorrect
42	EDS A.M. Logbook checksum incorrect
43	EDS A.M. Protected checksum incorrect
44	EDS Config SVER incorrect
45	EDS Protected SVER incorrect
46	EDS C.C. Config SVER incorrect
47	EDS C.C. Protected SVER incorrect
48	EDS A.M. Config SVER incorrect
49	EDS A.M. Protected SVER incorrect
50	Pressure Offset calibration complete
51	Pressure Offset calibration Failed
52	Unable to store pressure offset
53	Temperature sensor disconnected
60	DMD control to temperature setpoint
61	DMD start run
62	DMD stop run
63	DMD start tuning
64	DMD case temperature error
65	DMD sensor temperature error
66	DMD method file error
67	DMD sensor voltage error
68	DMD RF voltage error
69	DMD Vc voltage error
70	DMD sensor pressure error
71	DMD tuning process error
72	DMD gas flow error
73	DMD system voltage error
74	DMD communication error
75	DMD sensor error

VARIAN USERLINK APPLICATIONS

The schedule describes the data transfer between applications.



External Relays

The switch condition for the external Relays of the can be setup out of almost any parameter available in all application part of this schedule. Everything stored in the shared UserDataStore database can be used to setup a switch condition, since every Varian userlink application is capable to store its specific results into this database. To store CP-Maitre Elite 3.2 concentrations into the UserDataStore database look at topic Common Tab of Instrument Method Setup.

instrument status including analog inputs

The instrument status and analog inputs can be stored into the UserDataBase database. Applications like Mlink32, PCI1000Com and I/O Control can retrieve these from the database.

UserDataStore addresses of Varian userlink applications

Find below a table of relevant UserDataStore addresses, which can be used, for alarming purposes. The addresses are all part of the Varian Userlink applications: ISOCAL32, BTU32, InstrumentNorm32 and Mlink32.
The addresses are specific for each instrument (maximal four instruments)

ISOCAL32		**BTU32**		**ValveControl32**	
Address	**Parameter**	**Address**	**Parameter**	**Address**	**Parameter**
0	Calib.Level	200	Calib.Level	402	Current Stream Position
1	Total-ESTD	201	Total-ESTD	404	Calib.Level
2	Total-Estimates	202	Total-Estimates		
3	Hs_MJ/m3	203	Hv_actual	**InstrumentNorm32**	
4	Hi_MJ/m3	204	Hv_dry	**Address**	**Parameter**
5	Rel.Density	205	Hv_saturated	0	Calib.Level, SampleID
6	Density	206	Hv_act._MJ/m3	1	Total-ESTD
7	Wobbe_MJ/m3	207	Wobbe	2	Total-Area
8	MoleWeight	208	MoleWeight	20	ESTD Peak1
9	MoleWeight ratio	209	MoleWeight ratio	109	ESTD Peak90
10	Hs_KW/m3	210	Rel.Density	110	ESTD% Peak1
11	Wobbe_KW/m3			199	ESTD% Peak90
20	ESTD Peak1	220	ESTD Peak1		
109	ESTD Peak90	309	ESTD Peak90		
110	ESTD% Peak1	310	ESTD% Peak1		
199	ESTD% Peak90	399	ESTD% Peak90		

EliteExport.dll

Address	Parameter
501	Calib.Level and SampleID
511	Stream Position from CP-Maitre Elite
512	Total ESTD summed of all channels

EliteExport.dll or Mlink32

520 and up	User defined parameters as defined in the UserDataStore sheets output section of Mlink32 or as defined in the EliteExport.ini file.

EXTERNAL DEVICES

The is equipped with several external I/O's in order to control external devices or to synchronize with external devices. External devices can be external pump(s), alarms, Auto Sampler, etc.

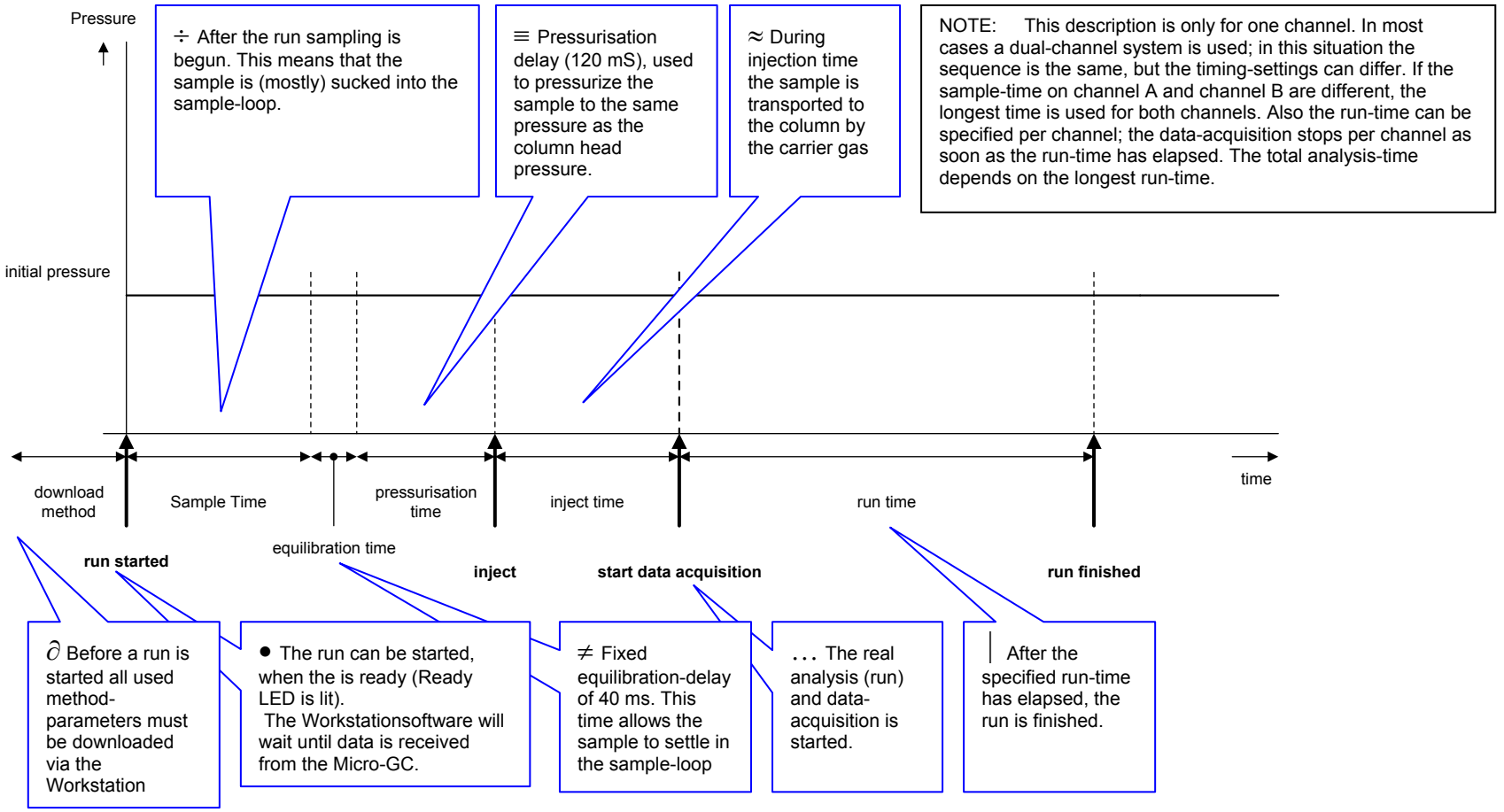
The following I/O's are standard available:

1. Two external serial ports (Com2: RS232, Com3: RS485)
   The driver supports control of the VICI electric actuated multi positional valve via Com2 (see also COM_port_details on page 37).
2. Two external relays (contact closures)
   The driver supports alarming purposes, Auto-Sampler control via solenoids and external pump control (see also External_digital_IO on page 36).
3. External Start In
   The driver supports the start of the Micro-GC by an external device (Flow computer or PLC). The Micro-GC processes this event (start run) and passes the event to the driver (see also External_digital_IO on page 36).
4. External Start Out
   The "External Start Out" signal is directly controlled from the Micro-GC (see also External_digital_IO on page 36).
5. External Ready In
   The "External Ready In" signal is not processed in the Micro GC. The driver acquires this event. It can be used to synchronize with an external device (see also External_digital_IO on page 36).
6. External Ready Out
   The "External Ready Out" signal is directly controlled from the Micro-GC (see also External_digital_IO on page 36).
7. Six External Analog Input signals
   The driver supports the acquisition and processing of the External Analog Input signals (see also External_Analog_IO on page 36).

The VICI electric actuated multi positional valve

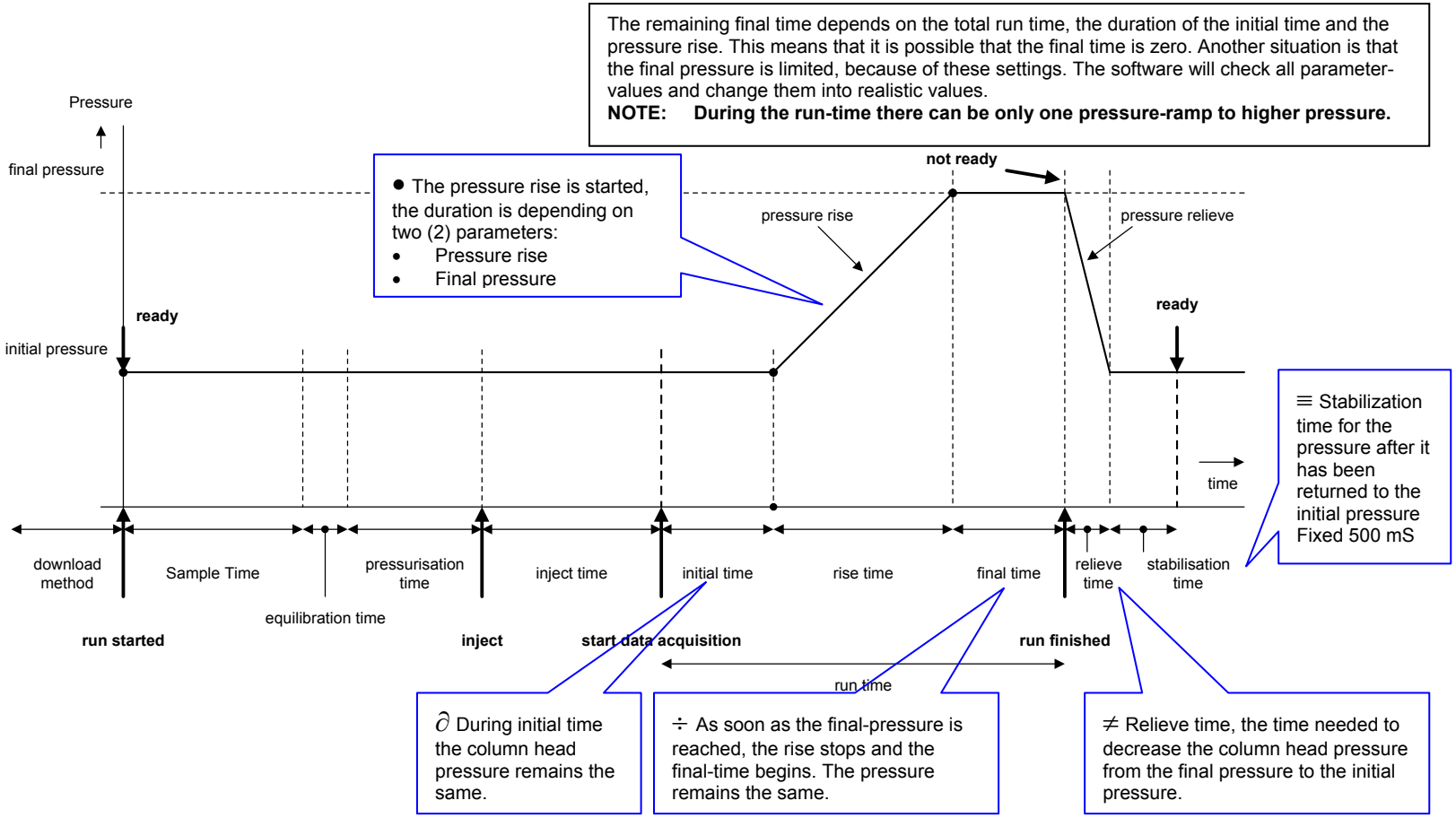
Cycle with static (electronic) pressure

This time diagram will help you to understand the Static (electronic) pressure cycle of the Micro-GC .


Pressure
÷ After the run sampling is begun. This means that the sample is (mostly) sucked into the sample-loop.
≡ Pressurisation delay (120 mS), used to pressurize the sample to the same pressure as the column head pressure.
≈ During injection time the sample is transported to the column by the carrier gas
NOTE: This description is only for one channel. In most cases a dual-channel system is used; in this situation the sequence is the same, but the timing-settings can differ. If the sample-time on channel A and channel B are different, the longest time is used for both channels. Also the run-time can be specified per channel; the data-acquisition stops per channel as soon as the run-time has elapsed. The total analysis-time depends on the longest run-time.
initial pressure
time
download method
Sample Time
pressurisation time
inject time
run time
run started
equilibration time
inject
start data acquisition
run finished
∂ Before a run is started all used method-parameters must be downloaded via the Workstation
● The run can be started, when the is ready (Ready LED is lit). The Workstationsoftware will wait until data is received from the Micro-GC.
≠ Fixed equilibration-delay of 40 ms. This time allows the sample to settle in the sample-loop
… The real analysis (run) and data-acquisition is started.
| After the specified run-time has elapsed, the run is finished.

Cycle with electronic pressure control

This timing diagram will help you to understand the electronic pressure control (EGC) cycle of the Micro-GC .
The diagram shows the situation in the Micro-GC , using electronic (programmed) pressure control. The timing before the injection is identical to the static pressure cycle.


The remaining final time depends on the total run time, the duration of the initial time and the pressure rise. This means that it is possible that the final time is zero. Another situation is that the final pressure is limited, because of these settings. The software will check all parameter-values and change them into realistic values.
NOTE: During the run-time there can be only one pressure-ramp to higher pressure.
Pressure
final pressure
initial pressure
ready
not ready
pressure rise
pressure relieve
ready
time
● The pressure rise is started, the duration is depending on two (2) parameters:
• Pressure rise
• Final pressure
≡ Stabilization time for the pressure after it has been returned to the initial pressure Fixed 500 mS
download method
Sample Time
equilibration time
pressurisation time
inject time
initial time
rise time
final time
relieve time
stabilisation time
run started
inject
start data acquisition
run finished
run time
∂ During initial time the column head pressure remains the same.
÷ As soon as the final-pressure is reached, the rise stops and the final-time begins. The pressure remains the same.
≠ Relieve time, the time needed to decrease the column head pressure from the final pressure to the initial pressure.

COLUMN MODULE CONDITIONING

Follow this procedure to make sure that any “water” that might be present inside the analytical column is removed before the TCD is switched on. Also follow this procedure if the Micro-GC or Micro-GC module has been stored for a long period.

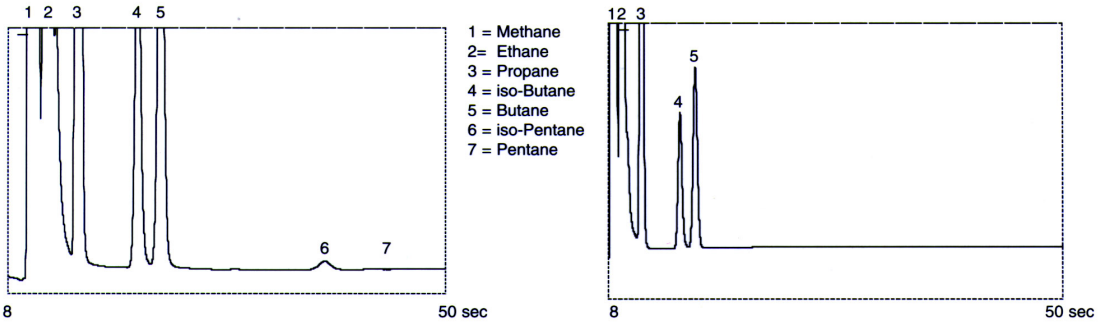
The detector filaments may be damaged if this procedure is not followed!

1. Switch off the TCD filaments in the method.
2. Set the column temperature of the module to the maximum temperature. ***Leave the filaments off!!***
3. Download this method to the Micro-GC.
4. Condition the column module, preferably overnight.

This will insure you that all the “water” has been removed from the column module and no damage will occur to the TCD filaments.

Backflush option

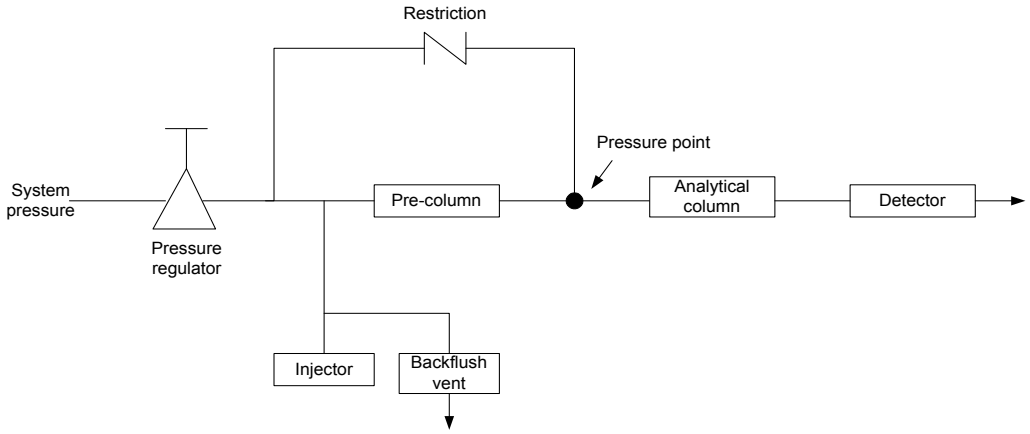
Backflush to vent is an advanced technique, which is used to prevent later eluting compounds to reach the analytical column and detector. The main reason for applying this technique is to keep the analytical column clean and reduce analysis time.
The Varian Micro-GC is optionally available with GC modules that incorporate backflush capabilities.



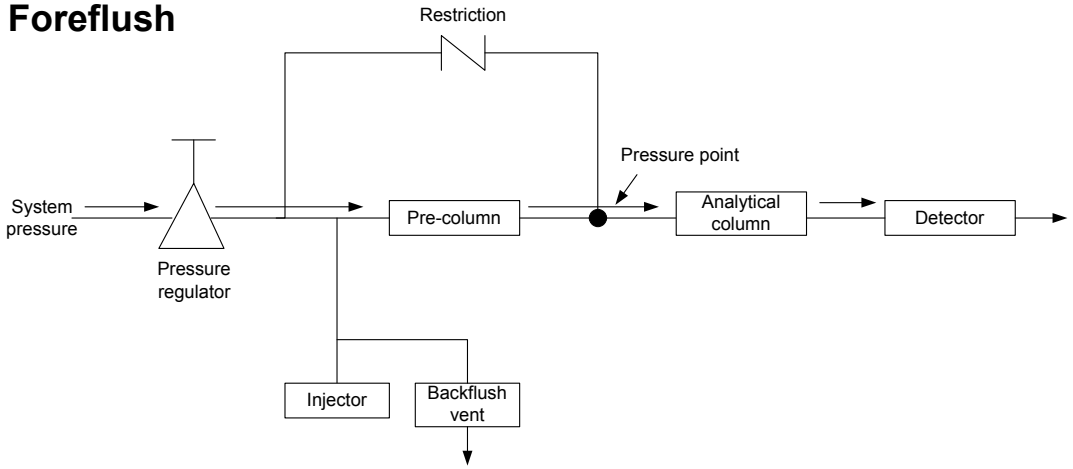
Natural gas analysis, straight.

Natural gas analysis, with backflush at 8 seconds.

A backflush system always consists of a pre-column and an analytical column. The two columns are coupled with a so-called pressure point, which makes it possible to invert the carrier gas flow direction through the pre-column at a preset time, the "backflush time".



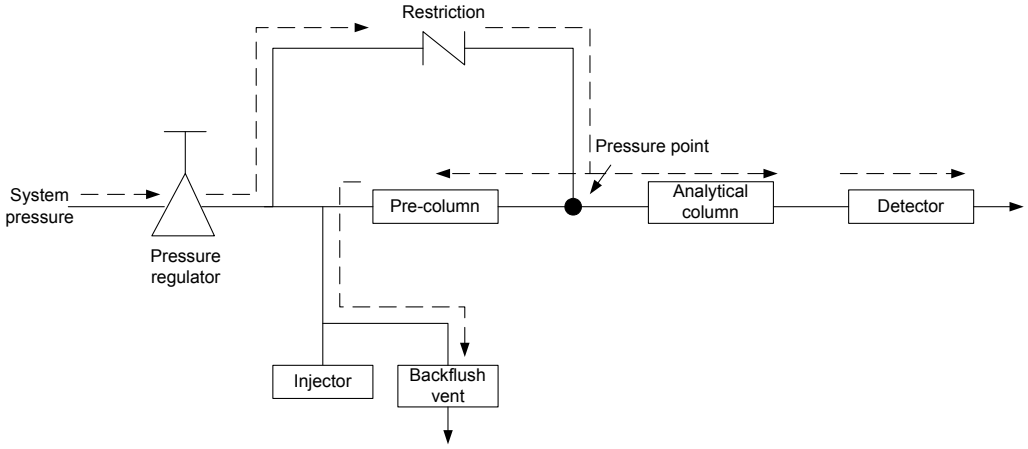
Foreflush



Description

The injector, two columns, and detector are set in line.
The sample is injected onto the pre-column where a pre-separation takes place; injection takes place in "foreflush" mode (see foreflush diagram).

Backflush



When all compounds which are to be quantified are transferred to the analytical column, the backflush valve switch (at the backflush Time) On the pre-column the flow is inverted and all compounds left on the pre-column are now (back) flushed to the vent (see backflush diagram). On the analytical column the separation goes on, because as there the flow is not inverted!

The standby mode for the is to be in the backflush configuration (if the instrument is equipped with the optional backflush valve).
Back flushing will ensure that the pre-column will be in good condition for the next run.

Tuning

Tuning of the backflush time is done by trial and error. Reducing the backflush time will transfer fewer compounds to the analytical column.

How to Tune

Obtain a chromatogram in foreflush. Check out the retention times of the compounds you have to quantify. Start at a backflush time of 10 seconds. Obtain a second chromatogram. Adjust the Backflush time (increments of 0.1 seconds are possible) until all components of interest are transferred to the analytical column and that all unwanted peaks are backflushed.
Be aware that a small pre-column is used. It is not always possible to cut between 2 peaks!
Backflush Time range 0.5 seconds until maximum run time.

Special value

BACKFLUSH TIME = 0 this puts the system in FOREFLUSH mode during run the entire run.

SHIPPING INSTRUCTIONS

If your Micro-GC for any reason must be sent back to the factory, it is very important to follow these additional shipping preparation instructions:

1. Add all the vent caps at the back of the Micro-GC.
2. Always include the power supply.
3. Include, if used, the inlet filter(s).

CLEANING INSTRUCTIONS

To keep the Micro-GC surface clean, refer to the remarks given below:

- Switch the Micro-GC off.
- Remove the power cable.
- Put protection plugs on the sample and carrier gas inlets.
- Put protection plugs on the Column vents.
- Use a soft (no hard or abrasive) brush to carefully brush away all dust and dirt.
- If the outer case is dirty (never clean the inside!) clean it with a soft, clean cloth dampened with mild detergent.
- Never use alcohol or thinners to clean the Micro-GC, these chemicals can damage the case.
- Be careful not to get water on the electronic components.
- Do not use compressed air to clean.

DISPOSAL INSTRUCTIONS

When the lifetime of the Micro-GC or parts of it has reached the end of its useful life, disposal must be carried out in accordance with all (environment) regulations applicable in your country.

ERROR LIST

ERROR HANDLING

During operation a series of events and error messages are generated indicating start or finishing of certain actions and procedures as well as smaller and fatal errors somewhere in the instrument. This section describes how micro-GC reacts to these events or messages.

The following error classes as well as the subsequent actions are available:

Class 0 ***Internal event.***
Basically these are only events indicating a certain procedure has started or finished. In no way do they influence the proper functioning of the instrument.

Class 1 ***Advisory fault*;** the instrument continues.
These are the less-critical errors, advisory errors not requiring immediate action from the user. The ongoing run may be minimally effected by it and thus need not to be stopped. Class 2 error messages indicate certain malfunctions of the instrument. Some errors of this type keep the instrument from becoming ready.

Class 2 ***Critical errors*** for logging; error LED ON.
These are critical errors for which the user needs immediate warning (window-pop at workstation! as well as Error-LED). The run in progress is to be stopped since its results will definitely be wrong. Corrective action by the user or instrument service may be required.

Class 3 ***Fatal errors*** for logging; instrument shut-down, error LED and buzzer ON.
These are fatal errors for which the user needs immediate warning! (Error-LED). An instrument shut-down will be generated. Corrective action by the user or service is required.

All errors, independent of class are to be transferred to reader (PROstation or web browser) connected for display (trouble shooting information) under instrument status.
All Class 1 and above errors will be logged on flash.
Individual numbers identify all errors; these numbers are built using the error class and a number. Events are not numbered.

ERROR LIST:

The General Error State as stored in UserDataStore address 1219 is composed of the following items:

The error must be handled as 'CLNNN' in which C=error class (severity), L=location and NNN=error number or event number.

The Error class contains of the following values: 0=diagnostic error, 1=advisory error, 2=critical error, 3=fatal error.

There are five locations: 0=main board, 1=channel 1, 2=channel 2, 3=channel 3 and 4=channel 4.

Error Class ©)	Error number (NNN)	Event/Error code	Description	Action needed
0	1	Init passed (event)	End of initialization phase	NA
0	2	Pressure restored	Pressure restored after Too Low Pressure	NA
0	3	Start flush cycle	Is a part of the initialization cycle	NA
0	4	Flush cycle passed	Is a part of the initialization cycle	NA
0	5	TCD calibrating	Automatic generation after method activation or download.	TCD off and temp. control to default
1	6	Too low pressure	Pressure drops below 35 kPa	Check gas supply
1	7	Pressure fault	Pressure state not ready after 5 minutes	Check gas supply or replace manifold
1	8	Low battery 1	Battery 1 low power (portable Micro-GC only)	Recharge battery
1	9	Low battery 2	Battery 2 low power (portable Micro-GC only)	Recharge battery
2	10	Sample line sensor fault	Sample line temperature sensor error	Heater turned off
2	11	Sample line temperature fault	Temperature not reached within 35 min (heater error)	Replace sample line heater
2	12	Injector temperature fault	Temperature not reached within 35 min (heater error)	Replace module
2	13	Column temperature fault	Temperature not reached within 35 min (heater error)	Replace module
1	14	TCD Temperature limit activated	Hardware protection activated	NA
0	15	EDS logging error	Unable to update EDS log	Call service
1	16	Low power supply	Voltage < 10 Volt	Recharge battery
2	17	Injector sensor fault	Injector temperature sensor error	Replace module
2	18	Column temperature sensor fault	Column temperature sensor error	Replace module
2	19	TCD control error	TCD voltage not or incorrectly set	Call service
2	20	TCD calibration failed	Any error during TCD calibration	Replace module or TCD controller board
2	21	Hardware r"set"	Instrument reset request from WS	NA
2	22	Pressure too high	Pressure > 450 kPa for at least 2 minutes	Replace manifold
3	23	Initialization error	During initialize	Call service
3	24	Internal communication error	During/after initialization, between MPU and IOC/IOE	Call service
3	25	Instrument EDS incorrect	Instrument Electronic Datasheet incorrect	Call service
3	26	EDS incorrect	Electronic Datasheet incorrect	Call service
3	27	Internal power failure	During/after initialization, internal supplies	Call service
0	28	Flush cycle aborted	Flush cycle stopped before completion	NA

Error Class ©)	Error number (NNN)	Event/Error code	Description	Action needed
0	29	GC module changed	Changing a channel (controller or module) and restarting the instrument	NA
0	30	TCD Gain calibrated	End TCD Gain calibration	NA
0	31	TCD Offset calibrated	End of Offset calibration	NA
0	32	Null String	Not used	NA
0	33	ADC reading out of range	Analog Digital Control out of range	NA
0	34	EDS Analytical Module incorrect	Electronic Data Sheet Analytical Module incorrect	NA
0	35	EDS Config checksum incorrect	Electronic Data Sheet Configuration checksum incorrect	NA
0	36	EDS Logbook checksum incorrect	Electronic Data Sheet Logbook checksum incorrect	NA
0	37	EDS Protected checksum incorrect	Electronic Data Sheet Protected checksum incorrect.	NA
0	38	EDS C.C. Config checksum incorrect	Electronic Data Sheet Channel Control checksum incorrect.	NA
0	39	EDS C.C. Logbook checksum incorrect	Electronic Data Sheet Channel Control Logbook checksum incorrect	NA
0	40	EDS C.C. Protected checksum incorrect	Electronic Data Sheet Channel Control Protected checksum incorrect	NA
0	41	EDS A.M. Config. checksum incorrect	Electronic Data Sheet Analytical Module Configuration checksum incorrect	NA
0	42	EDS A.M. Logbook checksum incorrect	Electronic Data Sheet Analytical Module Logbook checksum incorrect	NA
0	43	EDS A.M. Protected checksum incorrect	Electronic Data Sheet Analytical Module Protected checksum incorrect	NA
0	44	EDS Config SVER incorrect	Electronic Data Sheet Configuration Structure Version incorrect	NA
0	45	EDS Protected SVER incorrect	Electronic Data Sheet Protected Structure Version incorrect	NA
0	46	EDS C.C. Config SVER incorrect	Electronic Data Sheet Channel Control Structure Version incorrect	NA
0	47	EDS C.C. Protected SVER incorrect	Electronic Data Sheet Channel Control Protected Structure Version incorrect	NA
0	48	EDS A.M. Config SVER incorrect	Electronic Data Sheet Analytical Module Configuration incorrect	NA
0	49	EDS A.M. Protected SVER incorrect	Electronic Data Sheet Analytical Module Protected Structure Version incorrect	NA
0	50	Pressure Offset calibration complete	Notification Pressure Offset calibration is completed	NA
0	51	Pressure Offset calibration Failed	Calibration offset out of range	
0	52	Unable to store pressure offset	Pressure off set is out of valid range (range??)	
2	53	Temperature sensor disconnected	Temperature sensor not connect to instrument	Call Service
1	54	Not ready to start run	Issued by Safety Control Object in Hardware domain. Bridge Call to GC domain (Reporting Not Ready To Start Run Error)	Check Method
1	54	Stream selection failed	Stream selector (VICI) failed switching	Check Valve
1	55	Ambient pressure or temperature alarm	Issued by Safety Control Object in Hardware domain whenever ambient temperature has passed a certain value.	
1	56	Column cleaning	Instrument in column cleaning state	NA
1	57	Equilibrating temperature zones	Instrument stabilizing after column cleaning	Wait till Ready
	60	DMD control to temperature setpoint	Notification that DMD is warming up.	Wait for completion

Error Class ©)	Error number (NNN)	Event/Error code	Description	Action needed
0	61	DMD start run		NA
0	62	DMD stop run		NA
0	63	DMD start tuning		NA
1	64	DMD case temperature error	Case Temperature reading is outside of acceptable tolerance range	Cool down
2	65	DMD sensor temperature error	Sensor temperature is outside of acceptable tolerance range. If temperature was just reset, please wait for stabilization	Call Service
2	66	DMD method file error	The method file is not loaded or the file data is corrupted	Reboot
2	67	DMD sensor voltage error	Saturated ± sensor readings	Call service
2	68	DMD RF voltage error	RF voltage is outside of acceptable tolerance range	Call service
2	69	DMD Vc voltage error	Compensation voltage is outside of acceptable tolerance range	Call service
1	70	DMD sensor pressure error	Sensor pressure reading is outside of acceptable range	Call service
0	71	DMD tuning process error	Tuning process fail, previously calibrated values are kept for failed compounds	Confirm presence of compound in calibration gas
1	72	DMD gas flow error	Startup gas flow diagnostic fail	Check for empty gas tank or gas line leakage/ blockage
2	73	DMD system voltage error	Main supply voltage is outside of acceptable tolerance range	Call service
2	74	DMD communication error	Internal communication error	Reboot
2	75	DMD sensor error	Startup sensor diagnostic fail	Call service
3	76	IOC Communication error	MPU is not able to communicate with IOC	Call service
3	77	Read main board EDS error	Not able to read Main board EDS	Call service
3	78	Read channel controller EDS error	Unable to read EDS controller	Call service
3	79	Read channel analytical module EDS error	Not able to read analytical module EDS	Call service
3	990	Watchdog Error: Store Application report on flash error	Internal Software Error, can't store application report on flash memory.	Auto reboot
3	991	Watchdog Error: Store ErrorLog report on flash error	Internal Software Error, can't store ErrorLog reprt on flash memory.	Auto reboot
3	992	Watchdog Error: Instrument frozen (hazardous error)	Internal Software Error, software hanging	Auto reboot
3	993	Watchdog Error: OOA Timer error	Internal Software Error, OOA Timer could not be created.	Auto reboot
3	994	Watchdog Error: ACE reactor stopped	Internal Software Error, ACE reactor stopped.	Auto reboot
3	995	Watchdog Error: Event pump stopped for 20 s	Internal Software Error, Event pump stopped.	Auto reboot
3	996	Watchdog Error: IOC Fatal error 0)	Internal Software Error, IOC fatal error 0	Auto reboot
3	997	Watchdog Error: IOC Fatal error 1)	Internal Software Error, IOC fatal error 1	Auto reboot
3	998	Watchdog Error: IOC Fatal error 2)	Internal Software Error, IOC fatal error 2	Auto reboot
3	999	Watchdog Error: IOC Fatal error 3)	Internal Software Error, IOC fatal error 3	Auto reboot